Dissertation on

"FACTORS ASSOCIATED WITH GLYCEMIC CONTROL IN CHILDREN WITH TYPE 1 DIABETES MELLITUS"

Submitted in partial fulfillment of requirements of

M.D. PAEDIATRICS

BRANCH – VII

INSTITUTE OF CHILD HEALTH &HOSPITAL FOR CHILDREN

MADRAS MEDICAL COLLEGE

CHENNAI- 600 003

THE TAMILNADU

DR.M.G.R. MEDICAL UNIVERSITY

CHENNAI

APRIL 2015

CERTIFICATE

This is to certify that the dissertation entitled **"FACTORS ASSOCIATED WITH GLYCEMIC CONTROL IN CHILDREN WITH TYPE 1 DIABETES MELLITUS"***is* a bonafide work done by **DR.D.SELVAKUMAR** at Madras Medical College, Chennai in partial fulfillment of the university rules and regulations for award of M.D., Degree in Paediatrics (BRANCH VII) during the academic year 2012-2015.

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DECLARATION

I solemnly declare that this dissertation **"FACTORS ASSOCIATED WITH GLYCEMIC CONTROL IN CHILDREN WITH TYPE 1 DIABETES MELLITUS"** was done by me at Madras Medical College, Institute of Child Health and Hospital for Children, during 2012 - 2015 under the guidance and supervision of **DR.ANNAMALAI VIJAYARAGHAVAN, MD., DCH.,** This dissertation is submitted to **The Tamilnadu Dr.M.G.R Medical University** towards the Partial fulfillment of requirements for the award of **M.D Degree in Paediatrics (Branch – VII).**

Place: Chennai **Signature of the Candidate**

SPECIAL ACKNOWLEGEMENT

My sincere thanks to **Prof.R.VIMALA M.D.,** The Dean, Madras Medical College, for allowing me to do this dissertation and utilize the Institutional facilities.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to the Director and Superintendent of ICH & HC **Prof S.SUNDARI, M.D., DCH.,** for permitting me to carry out this study.

I am indebted to **DR.ANNAMALAI VIJAYARAGHAVAN, MD., DCH.**, Professor of Paediatrics and my beloved unit chief, Institute of child health and Hospital for children for his valuable suggestions and guidance.

I would like to thank **DR.REMA CHANDRAMOHAN,MD.,DCH.,** Professor, department of Diabetology, ICH and HC for her constant encouragement and supervision throughout the study process.

I would like to thank **DR. MANI, DR. BALAKRISHNAN, DR. PERUMAL PILLAI, DR. SURESH, DR.SRIDEVI** and **DR.DAKSHAYANI,** the assistant professors of ICH and HC for their continuous close scrutiny of the project.

I would like to thank our **REGISTRAR DR. SRINIVASAN.S** for his constant encouragement and continuous guidance in completion of this project.

I would like to extend my sincere gratitude for the patients and parents for remaining a part of this study, without whom this study is impossible.

I would like to thank my fellow post graduates for their sincere support and criticism.

INSTITUTIONAL ETHICS COMMITTEE
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CERTIFICATE OF APPROVAL

To

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Dear **Dr.D.Selvakumar**,

The Institutional Ethics Committee of Madras Medical College, reviewed and discussed your application for approval of the proposal entitled "**Factors associated with Glycemic control in Children with Type-I Diabetes Mellitus**" No.18042014.

The following members of Ethics Committee were present in the meeting held on 08.04.2014 conducted at Madras Medical College, Chennai-3.

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We approve the proposal to be conducted in its presented form.

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The Institutional Ethics Committee expects to be informed about the progress of the study, and SAE occurring in the course of the study, any changes in the protocol and patients information / informed consent and asks to be provided a copy of the final report.

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File name:	dm_plagiarism.docx
File size:	147.38K
Page count:	106
Word count:	9,640
Character count:	51,508
Submission date:	03-Oct-2014 03:21PM
Submission ID:	459870417

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder with heterogeneous etiologies characterized by hyperglycemia and disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion ,action or both.

The incidence of diabetes mellitus is increasing in children. The point of concern in children are the acute and chronic complications in the long run, need for home monitoring and hospital visits, long term involvement of parents and children and the detrimental effect on the growth and development of the child.

Classification of Diabetes mellitus:

Diabetes mellitus can be classified into the following

1. Type I Diabetes – in which the pancreatic beta cell destruction usually leading to

absolute insulin deficiency

A. Immune mediated

B. Idiopathic

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CONTENTS

ABBREVIATION

SMBG	-	Self monitoring of blood glucose
DCCT	-	Diabetes Control and Complications Trial
HbA1c	-	Glycosylated hemoglobin
T1DM	-	Type1 diabetes mellitus
DKA	-	Diabetic ketoacidosis
WHO	-	World health organization
HLA	-	Human leucocyte antigen
BMI	-	Body mass index
ICH&HC	-	Institute of child health and health centre
NPH	-	Neutral Protamine Hagedorn

ABSTRACT

Background

Type I diabetes mellitus is a chronic metabolic disorder with heterogeneous etiologies characterized by hyperglycemia as a cardinal biochemical feature. Patients with Diabetes mellitus are at increased risk of morbidity and mortality due to the micro and macrovascular complication caused by diabetes. Maintaining strict glycemic control in type I DM reduces the incidence and progression of long term complication. There are various risk factors found to be associated with poor glycemic control. Identification of risk factors associated with poor glycemic control is necessary, so that appropriate intervention can be done to improve glycemic control and to prevent complication. As there is a lack of regional literature, this study was undertaken in our setting.

Aims and Objectives

To study the factors associated of glycemic control in Type I Diabetes Children.

Materials and Methods

This is a cross sectional study carried out at the diabetes clinic for children at tertiary care hospital ICH & HC in Chennai. Children attending the clinic were enrolled into the study after obtaining informed

consent from the parent / guardian. A structured questionnaire was used to collect date from the parents/guardian. Glycemic Control was assessed by measurement of glycosylated Hb .Data entry and analysis was done using Epi Info Software Version 3.5.1 and SPSS version 16.

Results

99 participants were recruited into the study. The mean HbA1C was 9.16% (SD2.168) came under a fair control group. 31 children had age appropriate glycemic control. The children with good glycemic control had a statistically significant level of hypoglycemic p=0.041. 53 children presented with DKA as initial onset of diabetes mellitus.

21 children were hospitalized for inter current illness.

Conclusion

The following factors namely age, duration of diabetes, insulin regimen, SMBG, compliance to therapy, follow up and serum cholesterol did not have impact on glycemic control. Hypo glycemic episodes were found to be more common in children with good glycemic control which was statistically significant.

Keywords

HbA1c, Glycemic Control, Type I DM

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The incidence of diabetes mellitus is increasing in children. The point of concern in children is the acute and chronic complications in the long run. Further the need for home monitoring and hospital visits, long term involvement of parents and children and the detrimental effect on the growth and development of the child are also a great concern.

Classification of Diabetes mellitus

Diabetes mellitus may be classified into

1. Type I Diabetes – pancreatic beta cell destruction usually leading to absolute insulin deficiency.
    A. Immune mediated
    B. Idiopathic

2. Type II Diabetes mellitus – predominantly due to insulin resistance.

3. Other specific types

   A. Genetic defects in pancreatic beta cell function – includes various form of Maturity onset Diabetes of Young (MODY)

   B. Genetic defects in insulin action

   C. Exocrine pancreatic diseases

   D. Endocrine disorders

   E. Drugs and chemical induced

   F. Infections

   G. Genetic syndromes associated with diabetes

4. Gestational diabetes mellitus

5. Neonatal diabetes mellitus

Type 1 diabetes is an autoimmune disease, in which environmental factors are thought to trigger the autoimmune destruction of pancreatic b-cells in genetically susceptible individuals.

EPIDEMIOLOGY

The WHO has estimated that about 180 million people in the world now have diabetes mellitus and by the year 2030 it is expected to double.

Type 1 diabetes is estimated around 10% of all diabetes, affecting nearly 1.4 million people in the US and around 10 to 20 million all over the world. About 40% of people with type 1 diabetes develop the disease before the age of 20 years.

Type 1 diabetes mellitus is one of the most common endocrine diseases among Children and its incidence is increasing worldwide.

There is a strong variation in geographical distribution but the overall annual increase is estimated around 3%. Of the 500000 children under 15 worldwide, half of them live in the developing nations. India being home to an estimated 97,000 children with type1dm. Recent survey has estimated that incidence of Type1 dm in Indian children is around 1 in 5000.(1)

Mean annual incidence rates for childhood type 1 diabetes (0–14 years age group) across the world have varied from fewer than 1 per 100 000 person years to more than 60 per 100 000 person years in recent decades.(2)

The incidence of type 1 DM according to Prasanna Kumar et al is as follows, the total children population from 0 to 14 years is 1.9 billions.

- The number of children with type 1 dm is 479.6 thousands.
- The number of children newly diagnosed is 75.8 thousand per year.
- The annual incidence of Type 1 dm is 3.0%. (3).

PATHO PHYSIOLOGY OF TYPE 1 DM

The absolute insulin deficiency in type 1 DM occurs from autoimmune destruction of pancreatic β cells in which environmental factors play an important role in genetically susceptible individuals.

IMMUNOLOGY

In most cases of type I DM there is T- Cell mediated autoimmune destruction of the pancreatic β cells, in which both the CD4 & CD8 T lymphocytes are involved. The auto antibody seems to appear many years before to the clinical onset of disease, indicating the process of destruction is gradual and occurs over a long period. This provides an opportunity to predict and potentially prevent type 1 DM before much β cell has been destroyed.

The markers of this autoimmune destruction include insulinoma antigen 2 antibodies (IA2A), autoantibodies to insulin (IAA), Islet cell antibodies (ICA), autoantibodies to glutamic acid decarboxylase (GADA).

A study conducted in Tunishia found a higher prevalence of auto immune markers, with 90.7% having 1 or more auto antibodies (4).

GENETICS

Familial clustering and twin studies clearly indicate that genetic predisposition as a major contribution to Type I DM risk. Compared to the prevalence of 0.4% in general population, prevalence in sibling is about 6%.

The concordance rate ranges from 30-65% in monozygotic twins where as dizygotic twins have concordance rate of 6-10%. The offspring of affected father has a chance of 6-7% risk which is more than double that of affected mother. In spite of large genetic component in type 1 DM 85% of newly diagnosed patients do not have family members with type 1 DM.

Type 1 DM is mostly associated with HLA class II located in the chromosome 6 p21. Most of the classically known predisposition effects of HLA DR3 and DR4 are actually due to linkage disequilibrium with DQ.

ENVIRONMENTAL FACTORS

The environmental factors play an imminent role in the contribution to the etiology of type 1 dm .It can be correlated to that, 50% or so of monozygotic twins are discordant for type 1 dm, the variation in the rural and urban areas populated in same group of people, incidence rate changes when people migrate from one region to another and there is an occurrence of seasonality.

Viral infections

There are various virus seem to play a role in the pathogenesis of Type 1 DM but till now no single pathogen and no pathogenesis has been proved in the environmental etiology of Type 1DM. The various viruses implicated to the etiology in genetically susceptible host are

1. Congenital rubella syndrome

   There exists a clearest evidence of role of viral etiology in Type1DM for congenital rubella syndrome. The prenatal infection

causes upto 70% of b cell autoimmunity, out of which about 40% develop the disease of Type1DM.

2. It has been shown in studies that entero virus has been associated with development of diabetes associated antibodies in some population (5).
3. Mumps

Hygiene hypothesis

Hygiene hypothesis implies that the lack of exposure to infections during the childhood period may somehow increase the chances of autoimmune diseases, including Type1DM. Further the rate of auto immune disorders and Type 1DM is in a lower range in the underdeveloped countries than in the developed nations.

Diet

The risk of Type1DM decreases with breast feeding due to either directly or indirectly by the delay in the cows milk exposure. If there is an early introduction of cows milk or to gluten the chances of developing autoimmunity is high due to the leakiness of the immature gut to the protein antigens.

Other dietary factors implicated are

- Omega 3 fatty acids

- Vitamin D, Vitamin C, Vitamin E

- Zinc

COURSE OF DISEASE PROCESS

The natural course of Type IDM involves the following stages.

1. Initiation of auto immunity.
2. Preclinical auto immunity progressive loss of β –cell function.
3. Onset of clinical disease.
4. Transient remission.
5. Established disease.
6. Development of Complication.

Initiation of autoimmunity

There are multiple factors implicated in the initiation of autoimmune process namely genetic susceptibility, environmental factors like diet during infancy, viral infection and even psychological stress. In the majority of the children who are diagnosed before 10 years of age, the first signs of autoimmunity appear before 2 years of age.

Onset of Clinical disease

The onset of clinical disease of Type 1DM indicates that there is a progressive β –cell destruction. It appears that, in younger children the β –cell destruction is more rapid and complete than the older children and adults. Studies indicate that 40% of the β –cell mass is preserved, this

may be important in a newly diagnosed patients where secondary prevention is possible.

During the onset of clinical disease the following symptoms occur

Increased thirst

Increased Urination

Weight loss despite increased appetite.

Honey Moon Period

In this phase, when the patient in initiated on insulin therapy, the β –cells regain the functional capacity, producing some insulin for a short period of time.

Intensification Phase

During this phase the destruction of β –cells continue and control of blood glucose is much more difficult.

Total diabetes : This phase is characterized by complete insufficiency of insulin due to total destruction of β –cells.

Clinical Features and Complication of Type IDM

The patient present with different clinical features depending on the degree of insulinopenia. The symptoms arise due to hypoglycemia, glycosuria and ketoacidosos. The classical symptoms of diabetes are polyuria, polydypsia and weight loss. Non specific features like malaise, headache and weakness.

When there is extremely low level of insulin keto acidosis develops, which may also be an initial presentation in children. DKA manifests as dehydration, vomiting, abdominal pain, breathing becomes acidotic and sensorium decreases, finally coma occurs.

Micro and Macrovascular Complications

The most important primary pathogenic factor for the development of complications in Type 1 diabetes mellitus is hyperglycemia. Hyperglycemia leads to activation of various biochemical reaction. The pathogenic pathways involved are

a) Accumulation of polyol
b) Formation of advanced glycation end products
c) Injuries caused by oxidative stress
d) Finally there is activation of protein kinase C

The above mechanisms make a combined effect and then leads to further cellular, structural and functional changes.

The biochemical alteration leads to both Acute and Chronic complication. The Acute Complications that manifests in Type1DM are DKA and hypoglycemia while chronic complication include retinopathy, nephropathy, neuropathy and growth disturbances.

HYPOGLYCEMIA

The most common acute complication of Type 1 DM in children is hypoglycemia. The symptoms of mild hypoglycemia are mostly due to the compensatory sympathetic stimulation like tremor, pallor, cold sweat and palpitation. As the glucose level further decreases symptoms of neuro glucopenia predominates like fatigue, lightheadedness, confusion, loss of consciousness. If there is a frequent bouts of hypoglycemia it can result in hypoglycemic unawareness

In hypoglycemic unawareness there is progressive decrease in blood glucose levels to elicit catecholamine counter regulatory response, so these patients are at increased risk of hypoglycemia associated autonomic failure.

The hypoglycemia can be prevented if the mismatch between three major components namely Insulin, exercise and food intake are managed properly.

When prolonged exercise is anticipated carbohydrate in take is recommended.

Newer insulin regimens by using long acting analogs are less likely to induce overnight hypoglycemia.

and glargine substitution for NPH has advantages.

DIABETIC KETOACIDOSIS

The most severe and life threatening acute complication of Diabetes is DKA. It is estimated that DKA occurs in 20-40% of children with new onset diabetes and children with known diabetes who omit insulin doses .If inter current illness is not managed adequately DKA occurs.

The incidence of DKA is around 46 cases per 10,000 persons by Faich et al.(6).

DKA involves a condition of low insulin levels and elevated counter regulatory hormones especially glucagon.

1. As the diagnosis of diabetes in younger children is more difficult and it is more likely to be delayed, infants and younger children age less than 5 years are in greatest risk of presenting with DKA.

   The clinical presentation of moderate to severe DKA are nausea, vomiting and abdomen cramps. Coma and disorientation are ominous signs and emergency assessments must be made for cerebral edema.

   The classification of DKA is Mild, moderate and severe.

Diagnosis of T1DM:

Current guidelines by the American Diabetes Association (ADA) recommend making a diagnosis of DM based on any of the following criteria(1):

1. HbA1c 6.5%
2. Fasting plasma glucose 126 mg/dl (7.0 mmol/l). Fasting is defined as no caloric intake for at least 8 hours.
3. 2-hour plasma glucose 200 mg/dl (11.1 mmol/l) during an OGTT.
4. In a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose 200 mg/dl (11.1 mmol/l).

The current World Health Organization (WHO) guidelines published in 2006 in Consultation with the International Diabetes Federation (IDF) recommend using fasting plasma glucose of 7 mmol/l or a 2 hour plasma glucose of 11.1 mmol/l during an OGTT as diagnostic criteria.

Management of Type1DM

The management of Type I DM involves many complexities it needs a team of person helping the patients to achieve and maintain the glycemic targets. Depending on the circumstances and available resources the multidisciplinary team should include the patient, diabetes specialist, primary care physician, dietician, nurse, psychiatrist as well as family and friends.

The Primary goals of therapy include:

- Establishment of realistic glycemic targets and insulin regimen adopted to each individual.
- The blood glucose in maintained to a near normal range as well as HbA1c to an optimum level.
- Efforts to reduce mortality and morbidity by preventing severe hypoglycemia and DKA should be made.

- The affected children quality of life should be maintained to a reasonable level.
- Proper screening for the expected micro and macrovascular complications
- Growth and development including psychological maturation should be attained to a optimum level.

Insulin therapy

Insulin therapy in the mainstay of treatment in children with Type I Diabetes. The ideal management is to hospitalize the child for 4 to 5 days even in the absence of any complication, to help the family to tide over crisis and also to gain support and confidence of home monitoring and treatment.

Insulin Preparation

Insulin analogues

The biochemical alteration of the insulin molecule alter its onset, peak and duration of action, so that it mimics the insulin action produced by the β –cells of the pancreas.

Short acting insulin analogues

Lispo and Aspart are the two short acting analogues. They have a rapid onset of action within 15 minutes, and the duration of action ranges from 2 to 4 hrs and 4 to 6 hrs respectively. It rapid onset of action makes it ideal for administration just before eating.

Intermediate acting insulin

Neutral protamine Lispro insulin (NPL). These are premixed insulin preparation similar to the human insulin NPH.

Advantages are

- Easy to administered in two daily doses.
- Used for patients who are not able to be successful in the task of mixing insulin.

Disadvantage

- Do not allow independent adjustments of either rapid or intermediate acting insulin.

Long acting Insulin

Insulin Glargine

It is a clear U 100 insulin preparation, as it is acidic it cannot be mixed with other insulin preparation. It has a peakless action and a 24 hour duration of action.

It should be given as 25-30 % of the total dose in toddlers and 40-50% in older children.

Advantages

Peakless action.

Less nocturnal hypoglycemia

Insulin Dose

The newly diagnosed type I DM children require approximately 0.5 to 0.75 U/kg/day.

There are some conditions where insulin sensitivity is decreased and they need a higher dose of insulin about 1U kg/ day or more.The conditions are

DKA,

Steroid use,

puberty

and infection.

The newly diagnosed children within a period of initiation of insulin therapy they may enter into honey moon phase where there is residual insulin production. The insulin requirement usually falls below 0.5 U/kg/day. As the destruction of β- cell progresses, the insulin dose gradually increases may require 1.5U/kg/day during puberty.

Insulin regimens

Conventional Insulin therapy:-

It refers to 1-2 times per day of insulin injection. The total daily dose is divided into 2/3 pre breakfast and 1/3 pre dinner. The ratio of

intermediate action and short acting (human regular) (NPH/Lenti) is taken in 70:30 ratio. Insulin is started at 60-70% of the total replacement dose. This has got less risk of hypoglycemia and more chances of microvascular complication.

Intensive regimen

This consists of completely separate basal and bolus administration where in a single day more than 3 times insulin is given. It has a basal insulin and bolus insulin given before food intake. This can be administered by multiple subcutaneous injection or continuous subcutaneous insulin infusion.

In this regimen the risk of hypoglycemia is more so that BGM is required 4-5 times/ day. But has a lower risk for microvascular complication.

Table 1: Insulins available in India and their action profile

Insulins	Onset	Peak	Duration
Rapid-acting	5-15 min	30-90 min	4 hrs
• Lispro			
• Aspart			
Short-acting	30-60 min	2-3 hrs	6-8 hrs
• Regular			
Intermediate-acting	1-2 hrs	4-6 hrs	10-16 hrs
• NPH			
Long-acting	2-4 hrs	No peak	20-24 hrs
• Glargine Detemir			
Pre-mixed 30% / 70% regular/NPH 50% / 50% regular/NPH	30-60 min	Dual	10-16 hrs

GLYCEMIC CONTROL

Strict glycemic control is needed to reduce the long term complications of Type 1 dm. This was proven in DCCT(Diabetes Control and Complication Trial)the multi centred trial done in1441 patients showed a strong association between long term glycemic control and the risk of microvascular complications .It has showed that intense diabetic treatment delayed the onset and progression of dibetes related complications.(7)

The main objective parameter assessed for glycemic control is the glycosilated hemoglobin (HbA1c) along with monitoring blood glucose levels.

The age group wise goals recommended by the American Diabetic Association in the year 2001 for plasma blood glucose and HbA1c for the Type 1 Diabetes is as follows :

1. The toddlers and preschoolers 0 to 6 years is

   Plasma blood glucose

   a) Before meals 100 to 180 mg /dl

   b) During Bedtime /overnight is between 110 to 200mg/dl

   HbA1c is less than 8.5%

2. For the school age children is

   Plasma blood glucose

   a) Before meals 90 to 180 mg /dl

   b) During Bedtime /overnight is between 100 to 180mg/dl

   HbA1c is less than 8%

3. For the adolescents and young adults is

   Plasma blood glucose

   a) Before meals 90 to 130 mg /dl

   b) During Bedtime /overnight is between 90 to 150mg/dl

   HbA1c is more than 7.5%

The following features should be taken into account while setting the glycemic controls

a) It should be individualized and the lower goals should be reasoned out on risk benefit assessment.
b) If the children has frequent hypoglycemia and hypoglycemic unawareness the goals should be modified accordingly.
c) When there is a discrepancy between pre prandial blood glucose values HbA1c values the post prandial blood sugar value should be measured so that it helps in assessing the glycemia in patients on basal bolus regimen.

ASSESSMENT OF GLYCEMIC CONTROL

GLYCEMIC CONTROL

Theortical goal of treatment is to restore the metabolic function to a possible near normal range and avoiding serious complications of therapy, especially symptomatic hyperglycemia and hypoglycemia. Although, most target recommendation for glycemic control are based on the data obtained from studies of adult patients with diabetes. The ideal goal for near normalization of blood glucose levels in children and adolescents is generally the same as that for adults (8).

Several studies indicate that hypoglycemic unawareness causes cognitive impairment in children who develop diabetes during infancy and early childhood (9)(10). Therefore maintaining very tight control of glucose level in children may be harmful. Further the long term follow of the DCCT participants were re assuring that there was no evidence of permanent neuro cognitive changes related to hypoglycemia in adolescents and young adults suggesting it may be age depend (11).

Care must also be taken to avoid poor glycemic control. Study conducted by schoenle EJ et al found a correlation between high long term HbA1c values and intellectual impairment in boys diagnose below 6 years of age (12). The prepubertal childrens are relatively protected from

microvascular complication, indeed it is extremely rare in children younger than10 years of age (13).

PUBERTY

Puberty is a challenging period of diabetes management from both physiological and behavioural point of view. Due to increase in the production of growth hormone and sex steroid hormones there is significant increase in insulin resistance and insulin requirements increase by 50% during pubertal growth and development (14).

Together with the physiological demands of puberty, behavioural issues add to the challenge of diabetes during developmental stage (15).

SMBG

Self monitoring of blood glucose enables the patients to evaluate their response to therapy and assess whether glycemic targets are being achieved or not . SMBG value can be useful in monitoring hypoglcemia and hyperglycemia so that medication can be adjusted. SMBG values are confounded by Aspirin, mannitol, paracetamol, vitamin C, vitamin E and hematocrit.

There is a significant bias in 41% of instruments which result in potential mis classification of > 12% of patients. SMBG recommended

3 – 4 times per day for diabetic patients on intensive treatment (16). Decreased frequency of blood glucose monitoring has been found to be a predicator of poor glycemic control (17),(18). Study by syein et al and Gunn B.B. Kristensen et al has observed that focused self monitoring of blood glucose intervention can lower HbA1c. A study in denmark showed imporved glycemic control with more frequent SMBG (19).

HbA1c

HbA1c is the most important parameter commonly measured for assessing chronic glycemia in current clinical practice. HbA1c is considered as a therapeutic target in the prevention and delay in the development of hyperglycemic complication.

ADA published the target age specific HbA1c is as follows.

<6yr 7.5 - 8.5%

6-12yr < 8%

13-18yr <7.5%

The glycation of hemoglobin takes place non-enzymatically in a 2 stage process within the erythrocytes. Initially there is a transient rise in glucose leading to a reversible formation of an aldimine. After prolonged exposure an Amadori rearrangement takes place forming an irreversible

ketoamine. The HbA1c value gives a time weighted indication of the average blood glucose over the life span of RBC.

It can be measured by the following method.

a) Cation exchange chromatography (HbA1c)
b) Affinity binding chromatography
c) Immunoassay

Cation exchange chromatography

It is a method in which separation is achieved by utilizing the differences in ionic interaction between the cation exchange group on the column resin surface and components of hemoglobin in the sample.

Advantages of (HbA1c)

- It has substantially less biological variability and less pre analytic instability.
- Does not need for fasting and timed samples.
- It is relatively un affected by perturbation in glucose levels.

REVIEW OF LITERATURE

Effect of Age and duration on Glycemic control

- Studies conducted in FRANCE and UK have shown that older age and longer duration of DM were associated with poor control.(18) (20).
- Panamonta et al conducted retrospective cohort study included 43 patients has found that higher age and longer duration of T1DM is associated with high risk of complications(21).
- A study conducted in Sudan showed an inverse relationship with older duration and higher duration is associated with good control (22) .Probable explanation is that these patients have better knowledge of diabetes and its management.

The Effect of sex as a factor on glycemic control

Dovk et al conducted a prospective study in 886 pediatric patients between the year 2000 to 2011 and has observed that the female patients had HbA1c value of an average 1.02% higher level(p=0.01)(23.).

Fritch et al in his study on predictors of DKA in children and adolescents with type 1 diabetes observed that adolescents girls with diabetes developed ketoacidosis than adolescents boys(24)

The effect of BMI on glycemic control

Viner RMet al conducted a longitudinal study in british people and have Observed that higher BMI in childhood independently increased the risk of Type 1 diabetes, this also supports the suggestions that obesity may provide link between type 1 and type 2 diabetes(25)

Ferrieria-Hermosilo et al performed a transverse evaluation in 120 patients with type 1 DM and has observed that BMI had a statistical significant p value when correlating with glycemic control(26)

The effect of Diabetes knowledge of caregivers on glycemic control

- In the Michiagen diabetes research and training centre, diabetes knowledge test done by Stallwood etal observed that higher caregiver knowledge was associated lower glycemic level(27).
- Similarly Butler et al observed that higher parental diabetic knowledge and less parental burden towards the care of diabetic children were predictive of lower HbA1C value.(28).
- However in India it was observed that, planned educational intervention program on the knowledge attitude and practices of type 1 diabetes resulted in significant improvement in the knowledge and attitude but no change in practice hence no improvement in HbA1C levels

The effect of adherence to insulin regimen on glycemic control

- Study conducted by Elgerbi in Zawia university among one hundred children with type 1dm have observed that poor compliance with insulin therapy was associated with poor glycemic control(29)

The effect of dosage of insulin on glycemic control

Studies from Newzealand, France and Australia have found that higher insulin dose per kg b.wt, poorer the glycemic control (17),(18).

Cameroglu et al and Thomas et al in his study on basal and bolus insulin requirements in children ,participants included 154 patients aged between 3 and 12 years and have found that basal insulin requirement increased with puberty in both the sexes and was lowest in the youngest group(30).

The effect of insulin regimen on glycemic control

Raskin et al conducted study in comparing insulin glargine verses NPH insulin have consistently shown that there is significant lower plasma glucose and a significant decrease in the variability of fasting blood glucose values in glargine pooled groups (31).

Rosenstock et al conducted a randomized controlled trial of comparing insulin glargine plus lispro with NPH plus regular insulin on intensive insulin therapy showed no significant differences in HbA1c levels and rates of self reported symptomatic hypoglycemia (32).

The effect of follow up visits on glycemic control

Hood et al conducted a meta analysis with a study population of about 2492 youths with type 1 dm observed that as the adherence increases ,HbA1c value decreases .It had a mean effect size of 0.28 (95% confidence interval:0.32 to 0.24 (33).

Adherence to any treatment regimen is particularly difficult if patients did not come to clinic in regular manner.

COMPLICATIONS RELATED

HYPOGLYCEMIC EPISODES

Johansen et al conducted a study in 3320 Danish children and adolescents in which hospital data were analyzed and observed that overall incidence of severe hypoglycemia was 45.1(95% confidence interval) per 100 patient years. He also added that patients treated with five or more insulin injections had a 31% reduced risk of hypoglycemia compared to patients on fewer daily injections.(34)

DKA

Jesic et al conducted a study among 366 children with type 1 diabetes mellitus, who are aged less than 18 years .It was conducted in Serbia and he observed that of all the children diagnosed as type 1 dm 32.9% presented with DKA. In that majority had either mild 69.6% or moderate 22.8% DKA presentation (35).

Johnson et al has observed that apart from the short term mortality there appears an increased risk of microvascular complications of diabetes with long-term survivors of DKA. (36)

From the studies conducted by Barnes et al it has been observed that the severity of DKA is less in patients where there is deficiency of counter regulatory hormones. (37).

COMORBID CONDITIONS

1) THYROID

Jung et at conducted a study on autoimmunity in 73 children with type 1 diabetes and found that majority of patients 87.7% had atleast one antibody .The significant higher antibody was insulin autoantibodies IAA. He also concluded that positivity of thyroid antibody could be used as an early predictor of development of thyroid autoimmune disorder among children and adolescent with type 1 DM.(38).

2) HYPERLIPIDEMIA

A cross sectional study conducted by Guy J et al, compared lipid profile and the prevalence of lipid abnormalities in 512 youths with type 1DM with mean duration 4.22 years, and has observed that youth with sub optimal level of glycemic control had elevated standard lipid levels of total cholesterol, LDL cholesterol .They also had significant elevated levels of apolipoprotein B and more small dense LDL particles. He concluded that youth with type 1 DM have abnormal lipid levels and atherogenic changes in lipoprotein composition even after small duration of diabetes.(39)

STUDY JUSTIFICATION

Type I DM is a growing problem in southeast asian countries. The WHO has recognized that developing countries face a double disease burden of both communicable and non communicable diseases. The non communicable disease has a major contribution to morbidity and mortality. Studies from different parts of the world have found a number of risk factors that predict poor glycemic control. Whether similar kind of variables play a role is to be determined in our resource poor settings. As the Regional literature of glycemic control in Type I DM is scarse, hence called for this study in our setting

AIM OF THE STUDY

AIM OF THE STUDY

To study the factors associated with glycemic control in children with Type 1 diabetes mellitus attending the diabetic clinic.

OBJECTIVES

To determine the effect of social and demographic factors, diabetes related factors and comorbid conditions on glycemic control.

METHODOLOGY

STUDY METHOD

Cross sectional study

STUDY PLACE

ICH&HC, MADRAS MEDICAL COLLEGE

STUDY PERIOD

MARCH 2014 TO SEPTEMBER 2014

STUDY POPULATION

99 Children attending the diabetic clinic at ICH&HC

STUDY METHOD

This study was carried out in the tertiary care children hospital ICH& HC in Chennai. In this hospital the study was done in diabetic clinic which is conducted two times in a week on Tuesday and Friday. Data was collected by the principal investigator using the structured questionnaire from the participants and parents/guardians

INCLUSION CRITERIA

Children with Type 1 diabetes mellitus attending to our clinic with age from 1 to 12 years.

The duration diabetes of more than 6 months

EXCLUSION CRITERIA

Newly diagnosed type 1 diabetes mellitus

METHOD OF COLLECTION OF DATA

Data was collected by Principal investigator using a structured questionnaire

The questionnaire has the following parameters

1. SOCIODEMOGRAPHIC FACTORS

Age, Sex, BMI

Primary care giver

Education of the primary care giver

Family history and family structure

2. **DIABETES SPECIFIC RISK FACTORS**

Onset and duration of diabetes

Insulin related factors

-Insulin dose

- Insulin regimen and mode of administration

Adherence to insulin

Follow up

SMBG

3. **OTHER PARAMETERS COLLECTED**

a) **COMPLICATIONS RELATED**

Hypoglycemic episodes

Hospitalization for inter current illness

Episodes of DKA

b**)** **INVESTIGATORY PARAMETERS**

1)HbA1c

In addition to routine and specific investigations, HbA1c estimation of all cases was done with high-performance liquid chromatography (HPLC) and the children were assessed for glycemic control as per American Diabetes Association Criteria by classifying them into preschoolers, school age and adolescents with HbA1c of < 8.5%, < 7.5% and < 7% respectively

2)Lipid profile

3)Thyroid profile

DIABETES RELATED

INSULIN REGIMEN

The patients in the study were following two types of insulin regimen one is twice daily regimen in which the soluble and long acting insulin are given in two doses per day. The other one is the multiple insulin dose regimen where basal or long acting insulin is given once or twice daily and bolus doses of short acting insulin were given in between.

INSULIN ADHERENCE

It is the degree to which patients adhere to their insulin regimen.

This parameter was assessed by the number of insulin doses missed in the last one week

Good - no missed doses / less than 3 missed doses per week

Poor - 3 or more than 3 missed doses per week

SMBG adherence

It is the degree to which the patients adhere to their SMBG testing at home

This was assessed by

Good - two times per week

Poor - less than 2 times per week

FOLLOW UP

In our diabetic clinic the assessment of follow up is done by the number of visits the children makes in 1 year period

Regular - 10 or more than 10 visits per year

Irregular - less than 10 visits per year

HYPOGLYCEMIC EPISODES

1) yes

This parameter is assessed by further classified into

a) symptomatic

mild- tremor, pallor, cold sweat and palpitation

moderate to severe –fatigue, lightheadedness, confusion, loss of consciousness and convulsion.

b) asymptomatic – blood glucose < 60 mg/dl

<3.3mmol/L

2) no

HOSPITALIZATION

During the study period if the child has been admitted for any inter current illness this has been taken into account.

EPISODES OF DKA

This is another acute severe complication of type1 dm

It is taken into account by whether the child had DKA during study period of 6 months.

COMORBID CONDITIONS

Lipid profile

Thyroid profile

ANTHROPOMETRY

Weight

An electronic weighing machine is used to measure the weight. During weighing the children were allowed for little clothing due to cultural restrains. It was checked thoroughly that the child did not make any contact with the objects nearby. It was measured upto the nearest 100gms.

Height

For children less than 2 years the length is measured using an measuring rod or infantometer. To measure length two persons are needed. Shoes must be removed and child was placed on a flat surface. The accompanied person usually the mother holds the head on the vertical board with child eyes facing upwards. The other person usually the trained person firmly presses the knees down so that they touch the horizontal surface. Then the mobile footboard was moved to touch the heels keeping the foot at right angle. Nearest 0.5cm was used to adjust the accuracy. If the child is more than two years old, stadiometer or vertical measuring rod was used. After removing the shoes the child was made to stand bare foot and the heels, buttocks, shoulders and occiput were touching the wall and child was looking straight. The chin was also

straight during the measurement (in Frankfurt planes).The curser or wooden board was placed flat on the head so that hair is flattened. Here the accuracy is measured to nearest 0.5cm.

In this clinical examination, the participants weight and height are measured accurately so that the insulin dosage body mass index can be calculated

BMI

The BMI is calculated and plotted using the WHO BMI for age Z score chart The results of Z score is interpreted in the following manner

1. Above 3 - Obese
2. Between 2 to 3 - Overweight
3. From 1 to 2 - Possible risk of overweight
4. From 1 to -2 - Normal
5. From -2 to -3 - Wasted
6. Below -3 - Severely wasted

Research assistants

In the diabetic clinic a nurse and a member of the support staff were selected to assist in the research for this study. They both were trained on how to use the weight and height scales accurately to measure.

STATISTICAL ANALYSIS

The collected data was first entered and cleaned then finally analyzed using Epi Info Software version 3.5.1 and SSPS (Software package for statistical sciences) version 16. The data regarding demographic characters and diabetic specific variables were plotted using frequency distribution tables. The mean was calculated for continuous data.

To derive the outcome of the association between the variables it was tested using chi square and fishers exact test. The derived statistical analysis of the mean was done using the t test and the ANOVA test. The derived value is considered statistically significant when the p value is less than or equal to 0.05.

ETHICAL CONSIDERATION AND CLEARENCE

The ethical clearance was obtained from the institutional review board.

The participants in the study were enrolled after obtaining written informed consent from the parents or from the guardian.

The confidentiality of the data collected during the study was maintained.

RESULTS

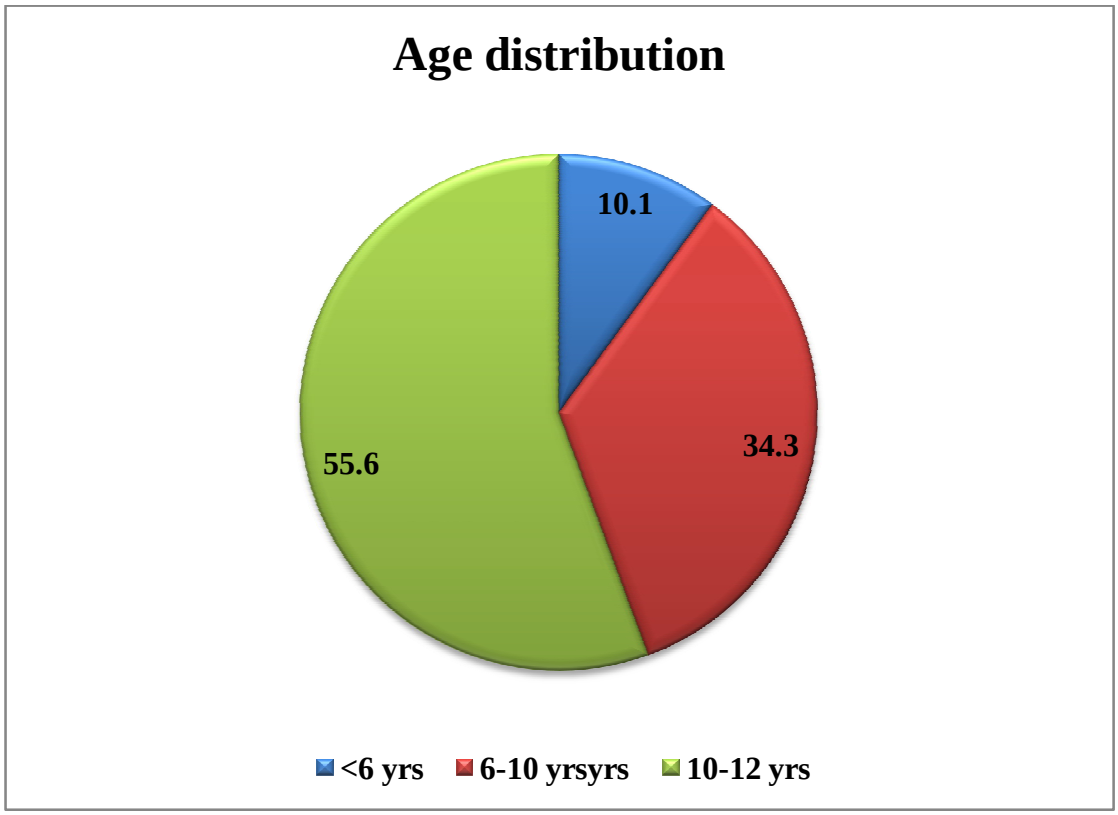
A total of 99 children with Type 1 diabetes mellitus were included and analyzed during the study period.

Age Group	Frequency	Percent
<6yrs	10	10.1
6-10 yrs	34	34.3
10-12yrs	55	55.6
Total	**99**	**100.0**

Table 1 shows that among the 99 students studied

1. 55.6% of the children belong to the maximum group of age from 10 to 12 years
2. Next comes the 6 to 10 years of age children to 34.3%

3 Children of less than 6 years occupy a small percentage of 10%



The chart 1 shows that majority of children in this study constitute to 10 to 12 years of age

SEX DISTRIBUTION

Sex	Frequency	Percent
Male	47	47.5
Female	52	52.5
Total	**99**	**100.0**

Table 2 shows that among the 99 students studied

1. Female children constitute 52.5% while the male have 47.5%

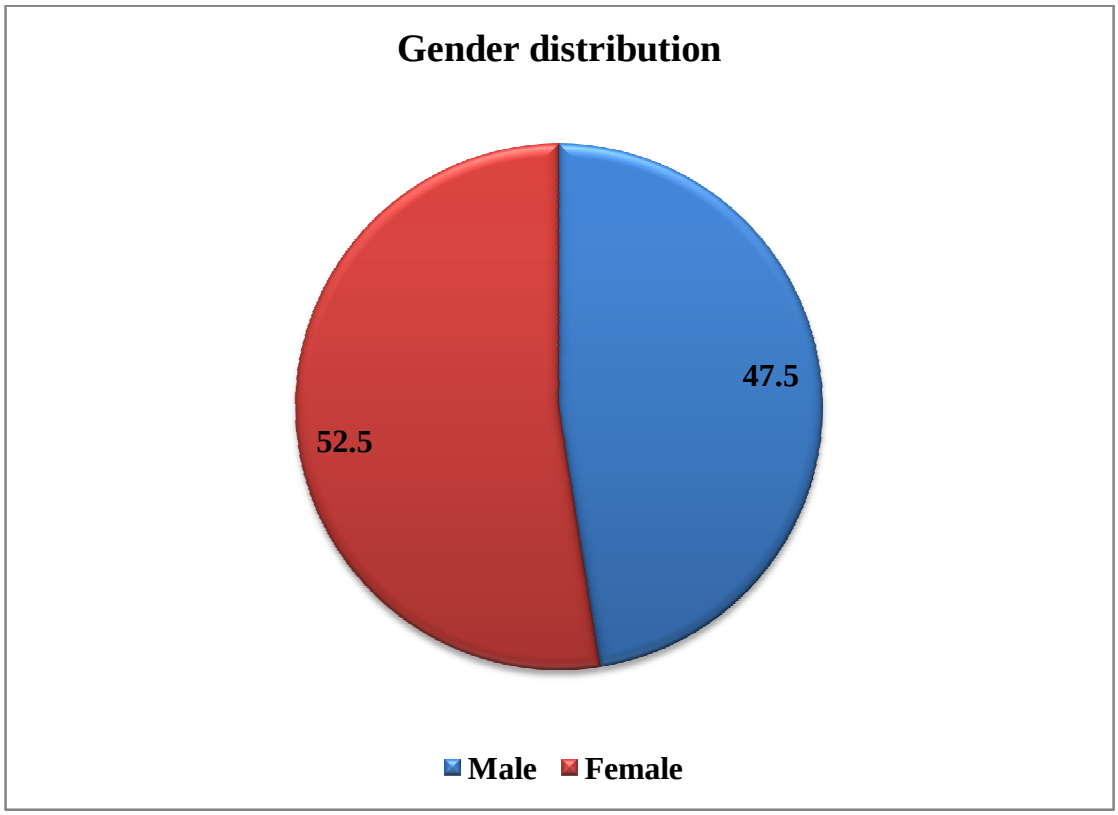


Chart 2.that the sex distribution chart shows a minor difference in distribution among childrens of type 1 dm

Females have a distribution of 52.5%

BMI GROUP

BMI	Frequency	Percent
Over wt	2	2.0
Risk of Over Wt	6	6.1
Normal	80	80.8
Wasted	6	6.1
Severly wasted	5	5.1
Total	**99**	**100.0**

Table 3 shows that among the 99 children studied belong to

1. Majority of the children about 80% belong to a normal range of BMI
2. About 6 and 2 percentage of children occupy the higher BMI range of risk of overweight and over weight respectively.
3. The wasted and severely wasted children occupy Nearly 6% each.

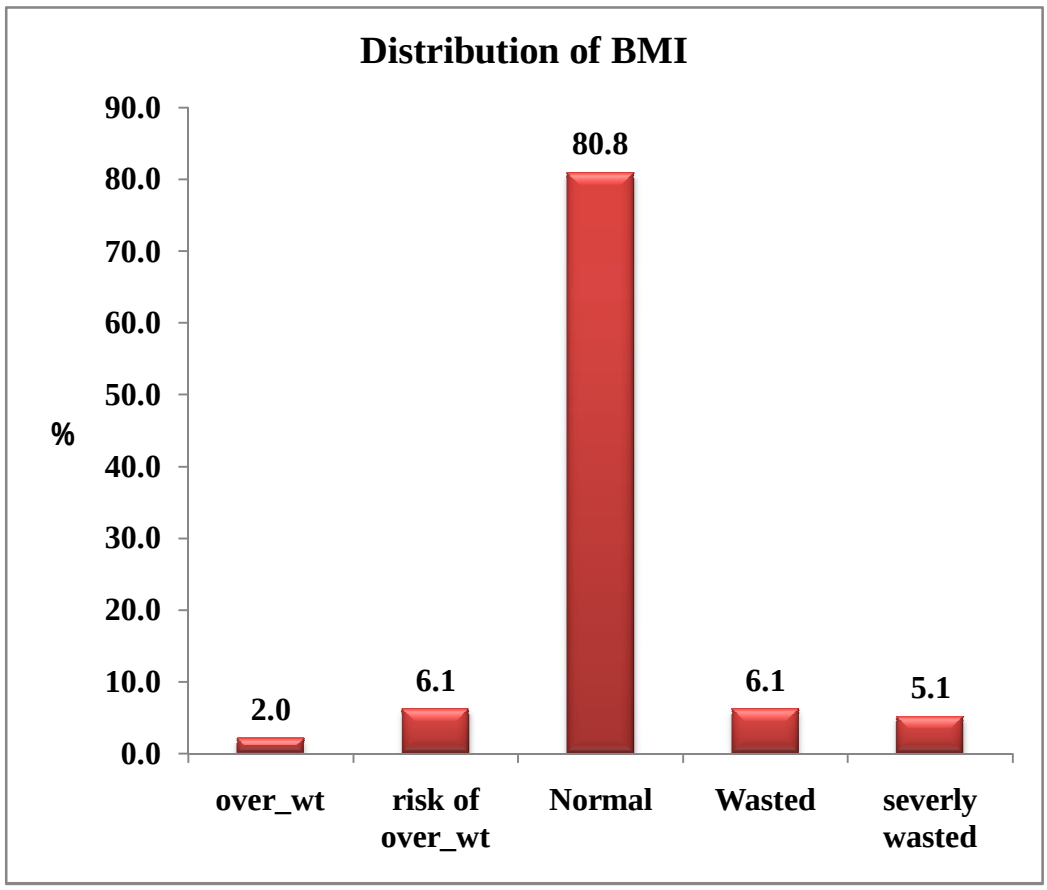


Chart 3 shows that 80.8% of children in the study group have normal BMI for age

CARE GIVER

Caregiver	Frequency	Percent
Father	11	11.1
Mother	84	84.8
Sibling	2	2.0
Guardian	2	2.0
Total	**99**	**100.0**

Table 4 shows that among the 99 children studied

1. In 84.8% of children mother were the primary care giver
2. The care giver percentage of father was 11 whereas sibling and guardian had 2% each.

EDUCATION OF PARENTS/CARETAKER

Education	Frequency	Percent
Illiterate	11	11.1
Primary	7	7.1
secondary	19	19.2
High school	33	33.3
UG/PG	17	17.2
Professional	12	12.1
Total	**99**	**100.0**

Table 5 shows that among the 99 children studied

1. 33.3% of care givers has studied upto high school

2. 19% completed secondary,

FAMILY STRUCTURE

Family structure	Frequency	Percent
Both	94	94.9
Single	2	2.0
No parent	3	3.0
Total	**99**	**100.0**

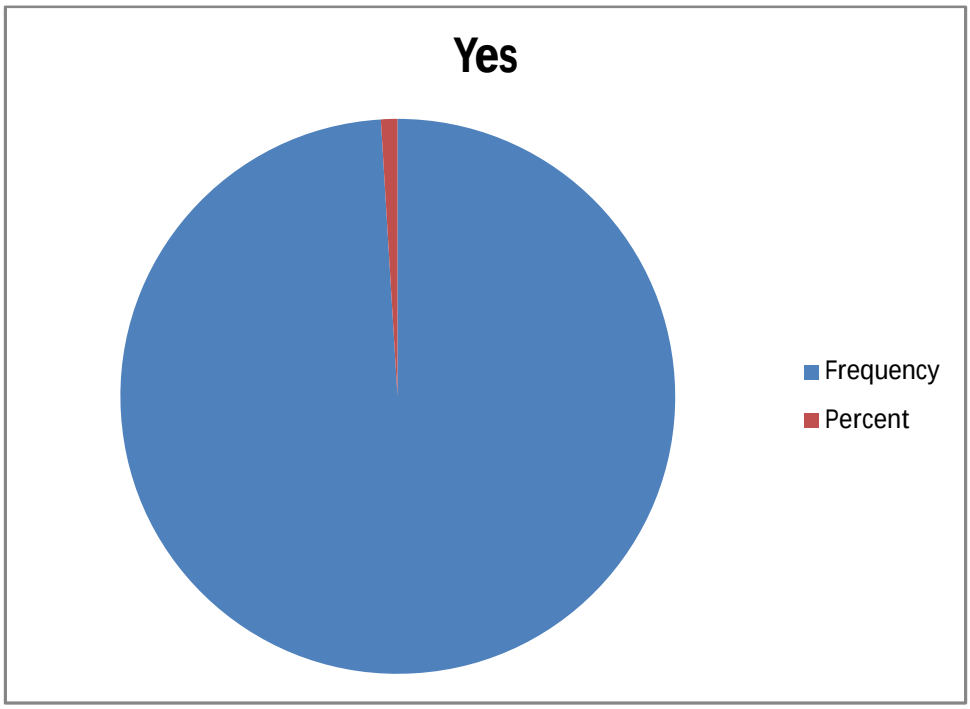
Table 6 shows that among the 99 children studied

- 94% live with both the parents
- 2 to 3% live with a single or without parents

FAMILY HISTORY OF TYPE 1 DM

Family history of type 1 dm	Frequency	Percent
Yes	6	5.9%
No	93	94.1%
Total	**99**	**100.0**

Table 7 shows that among the 99 children studied 5.9% have a family history of type 1DM



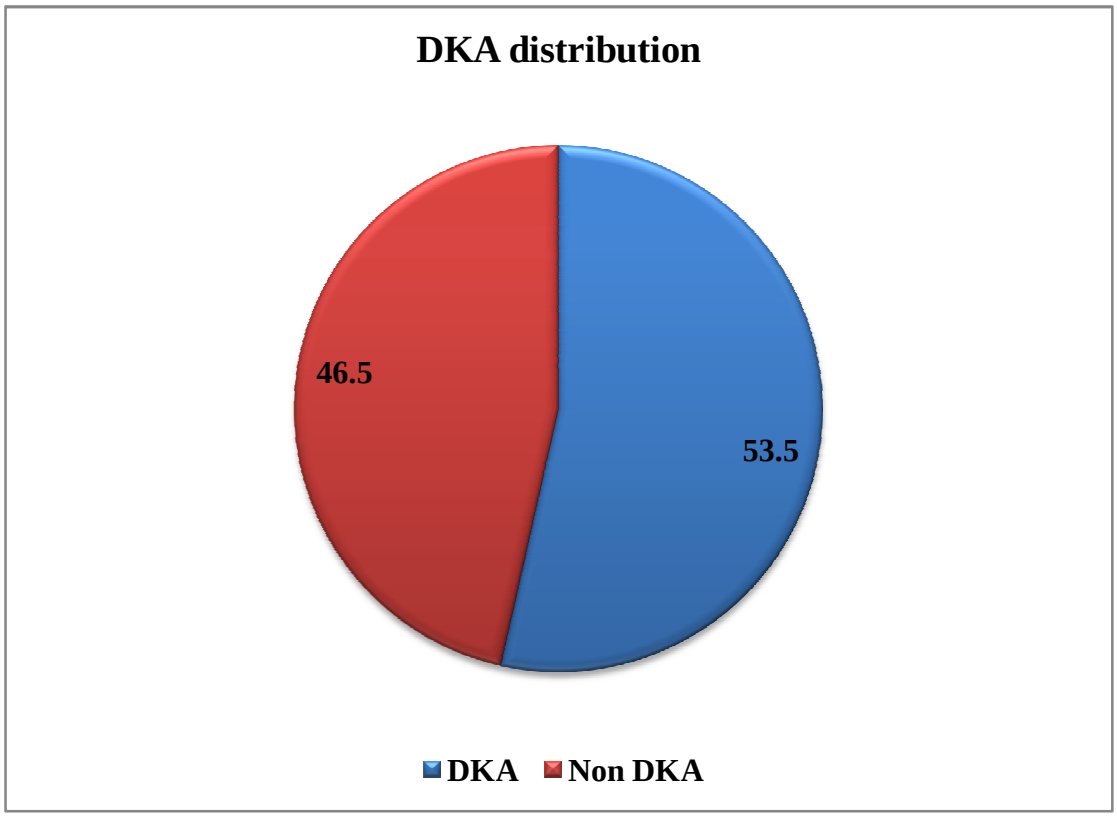
The pie chart shows the percentage of family history of type1 diabetes in our study

MODE OF ONSET OF TYPE1 DM

Mode of onset	Frequency	Percent
DKA	53	53.5
Non DKA	46	46.5
Total	**99**	**100.0**

Table 8 shows that among the 99 children studied

The mode of onset of DM with DKA was 53.5% whereas non - DKA was 46.5%



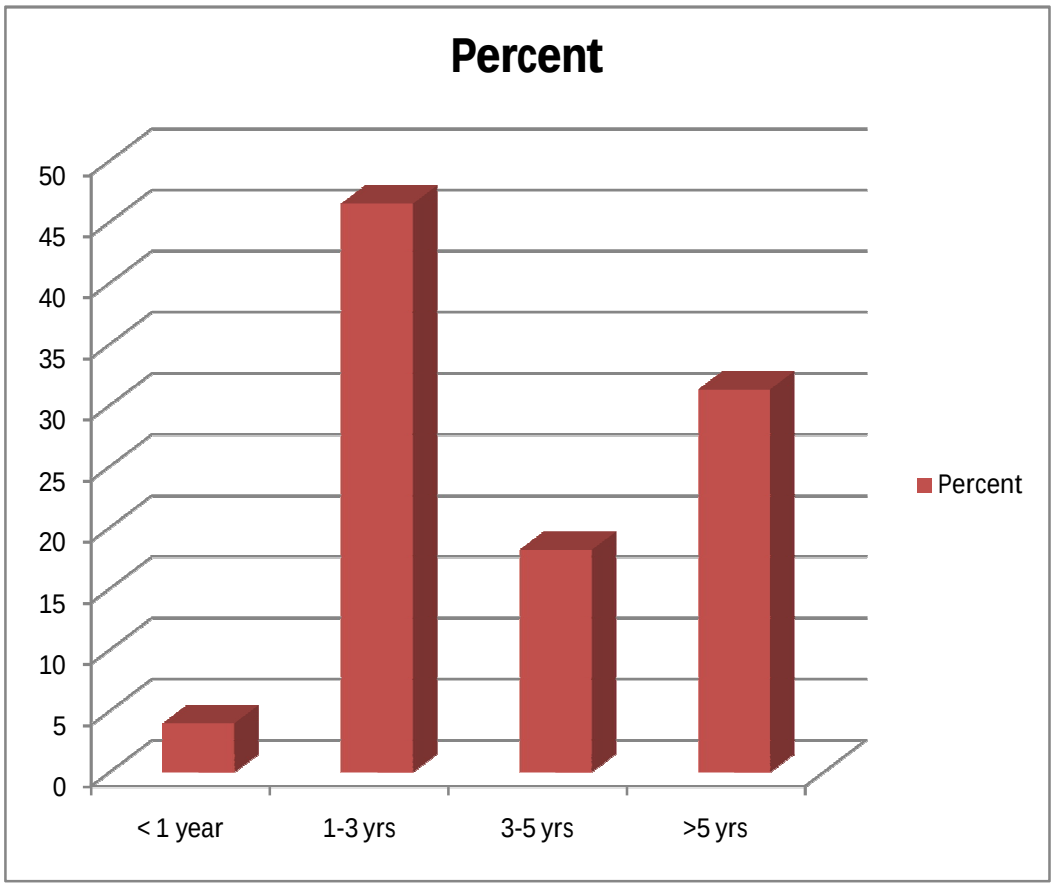
The chart 5 shows minimal higher level of onset for DKA children of 53.5%

DURATION OF DIABETES

Duration of Diabetes	Frequency	Percent
< 1 year	4	4.0
1-3 yrs	46	46.5
3-5 yrs	18	18.2
>5 yrs	31	31.3
Total	**99**	**100.0**

Table 9 shows that among the 99 children studied

1. 46.5% belong to 1 to 3 years duration
2. 31% had more than 5 years of duration
3. 18% and 4% had 3 to 5 years and less than 1 year duration of disease respectively



The chart 6 shows maximum duration of disease in 1 to 3 years

INSULIN DOSAGE		
Insulin dosage U/kg b.wt	**Frequency**	**Percent**
0.5-0.99	22	22.2
1.0-1.49	51	51.5
1.5-2.0	23	23.2
>2.0	3	3.0
Total	**99**	**100.0**

Table 10 shows the insulin dosage among the 99 children studied 51.5% had 1.0.to 1.49U/kg bwt, 23.2% had 1.5 to 2.0U/kg bwt 22.2% had 0.5 to 0.99 U/kg.bwt.3% had >2 U/kg bwt

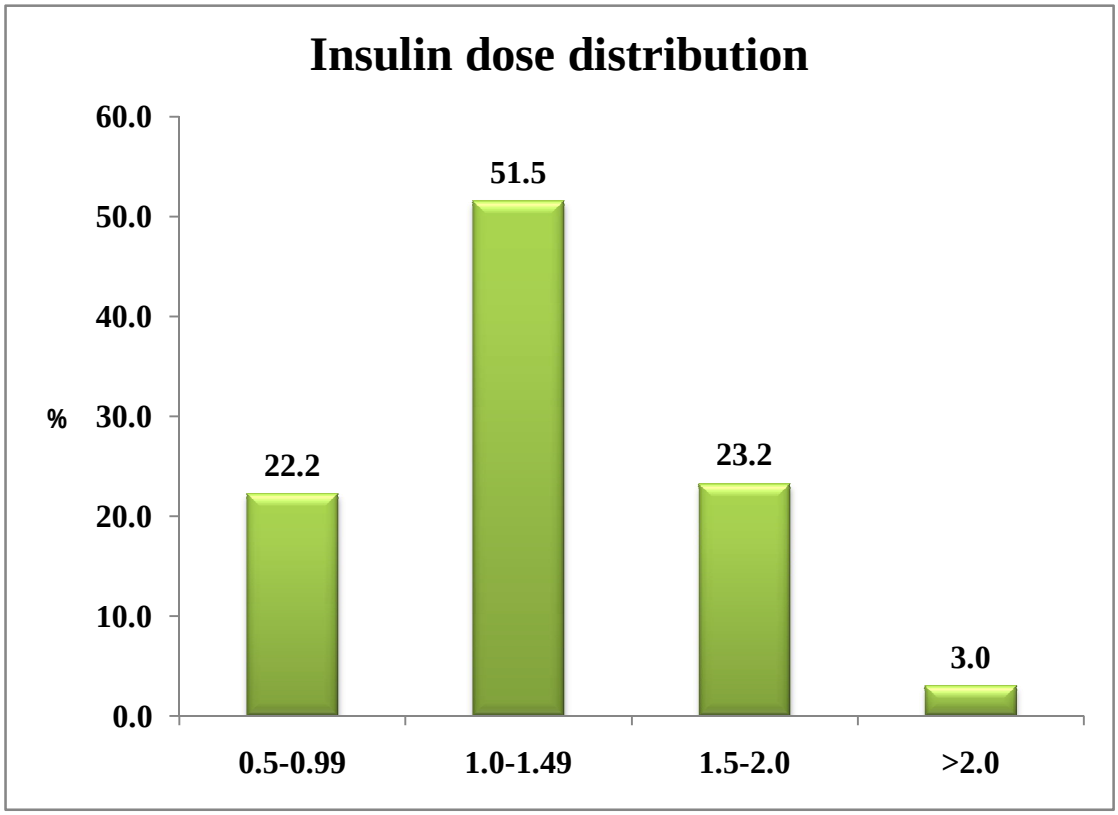


Chart 7 The bar diagram shows that majority of children are in a insulin dose of 1 to 1.5U/kg b wt

REGIMEN OF INSULIN

Regimen	Frequency	Percent
Twice	77	77.8
Thrice	22	22.2
Total	**99**	**100.0**

Table 11 shows that among the 99 children studied

1. Children on two dose regimen is about 77.8%
2. 22% children are under three dose regimen

MODE OF INSULIN ADMINISTRATION

Mode	Frequency	Percent
Pen	11	11.1
Conventional	88	88.9
Total	**99**	**100.0**

Table 12 shows that among the 99 children studied

1. Children injecting in conventional method is 88.9%, while 11.1% use pen

SMBG

SMBG	Frequency	Percent
Twice a week	84	84.8
Less than Twice a week	15	15.2
Total	**99**	**100.0**

Table 13 shows that among the 99 children studied

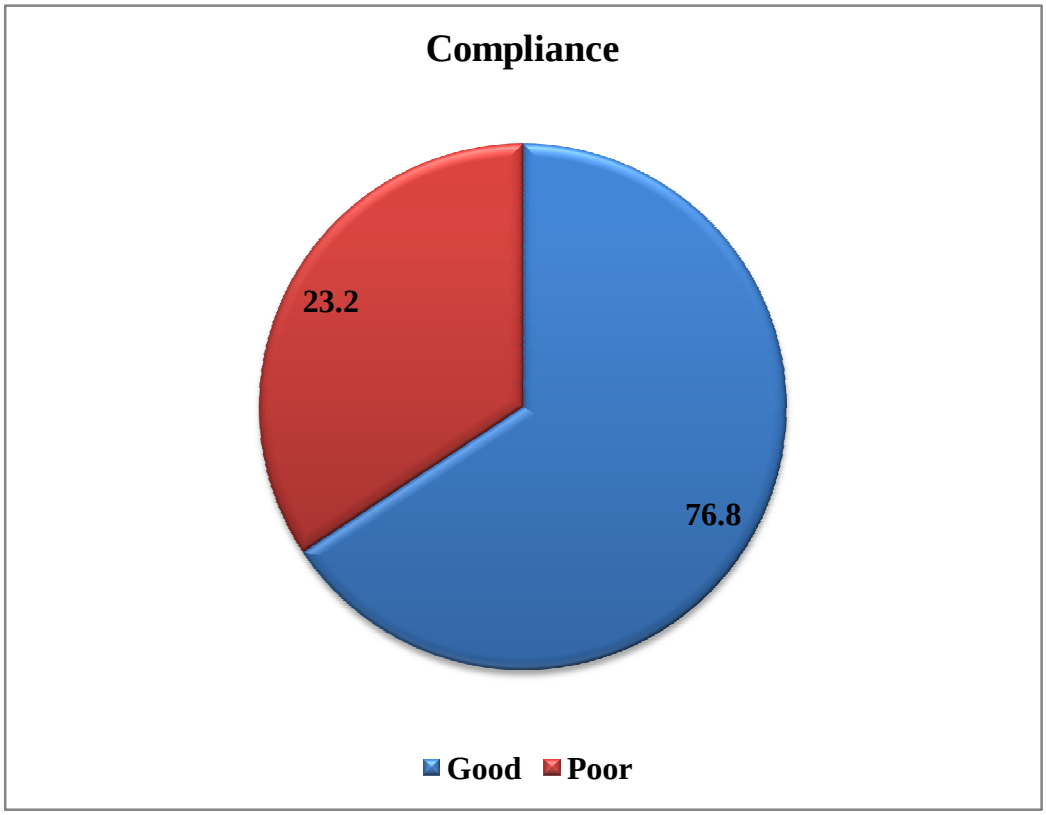
Twice a week 84.8%, less than twice a week 15.2%

COMPLIANCE

Compliance	Frequency	Percent
Good	76	76.8
Poor	23	23.2
Total	**99**	**100.0**

Table 14 shows that among the 99 children studied

- Good compliance 76.8%
- Poor compliance 23.2%



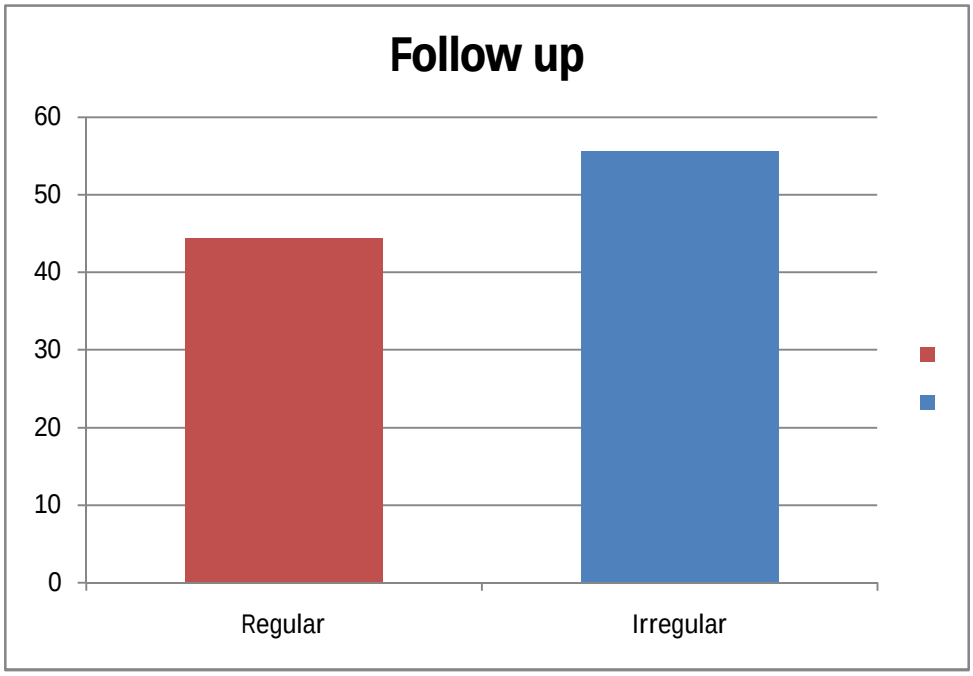
The chart 8shows the majority of the children about 76.8% have good compliance to insulin therapy compared to 23.2% have poor compliance.

FOLLOW UP GROUP

Follow up	Frequency	Percent
Regular(>=10 visits)	44	44.4
Irregular(<10 visits)	55	55.6
Total	**99**	**100.0**

Table 15 shows follow up visits of the children in the study group

1. There is a minimal difference of 10% between the above mentioned group.
2. The children who come irregularly to the clinic constitute about 55.6% compared to 44% of patients who come regularly.



The chart 9 shows that 55.6% have an irregular visit to the diabetic clinic

HYPOGLYCEMIC EPISODES

Hypoglycemic Episodes	Frequency	Percent
Symptomatic	43	43.4
Asymptomatic	14	14.2
No	42	42.4
Total	**99**	**100.0**

Table 16 shows frequency of hypoglycemic episodes of children in the study group

Episodes of hypoglycemia seen in 57.6%, out of that 43.4% was symptomatic, 14.2% were asymptomatic.

There was no hypoglycemic episodes in 42.4% of patients.

HOSPITALIZATION

Hospitalization	Frequency	Percent
Yes	21	21.2
No	78	78.8
Total	99	100.0

Table 17 shows that among the 99 children studied

21% of children had hospitalization for inter current illness 78% of children did not need hospitalization.

DKA

DKA	Frequency	Percent
Yes	5	5.1
No	94	94.9
Total	**99**	**100.0**

Table 18 shows that among the 99 children studied

About 94.9% of children did not have complication of DKA Only 5% had episodes of DKA.

SERUM CHOLESTEROL

Cholesterol	Frequency	Percent
Normal	47	47.5
Abnormal	21	21.2
Total	68	68.7
Missing	31	31.3
Total	**99**	**100.0**

Table 19 shows the serum cholesterol among the 99 children studied Normal in 69.1%, Abnormal in 30.9%.

SERUM TRIGLYCERIDES

Triglycerides	Frequency	Percent
Normal	39	39.4
Abnormal	24	24.2
Total	63	63.6
Missing	36	36.4
Total	**99**	**100.0**

Table 20 shows the serum triglycerides among the 99 children studied Normal in 61.9% ,Abnormal in38.1%.

The missing data are due to the children who did not come to diabetic clinic in fasting state to do lipid profile.

AGE GROUP WITH MEAN HbA1c

Age group	N	Mean HbA1c	Std. Deviation
<6 yrs	10	8.440	1.4393
6-10 yrs	34	8.812	2.3314
10-12 yrs	55	9.505	2.1377
Total	**99**	**9.160**	**2.1681**

Table 21shows Age group with mean HbA1c

In this study the mean glycosylated hemoglobin was 9.16%. (SD 2.1681)

The lower age group had a low HbA1c value of 8.4%

The higher age group children had high HbA1c value of 9.5%

Statistical test was done to analyze the association between glycemic control (HbA1c) and the following parameters

1. Age of the children
2. Duration of diabetes
3. Insulin dose
4. Insulin regimen
5. SMBG
6. Compliance to therapy
7. Follow up
8. Hypoglycemic episodes
9. Serum cholesterol

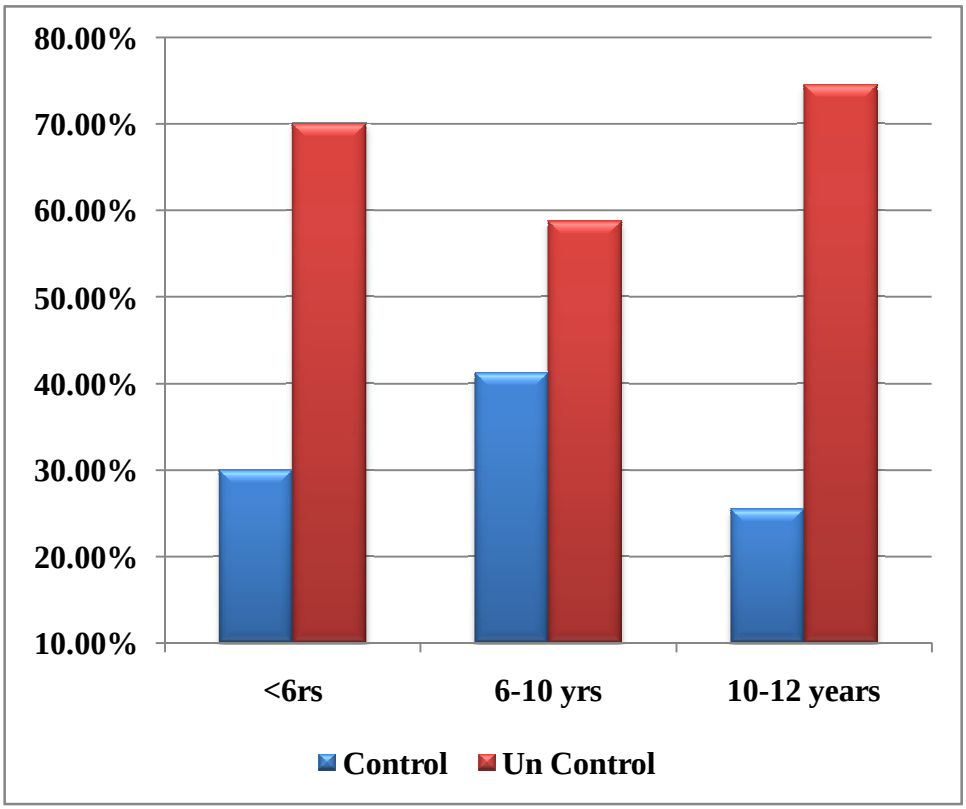
AGE WITH HbA1c

Age		HbA1c gp		Total
		Control	Un control	
<6yrs	Count	3	7	10
	% within age gp	30.0%	70.0%	100.0%
6-10 yrs	Count	14	20	34
	% within age gp	41.2%	58.8%	100.0%
10-12yrs	Count	14	41	55
	% within age gp	25.5%	74.5%	100.0%
	Count	31	68	99
	% within age gp	31.3%	68.7%	100.0%

P = 0.738

Table 22 shows no significant association between age and glycemic control

Age with HbA1c



The above chart 10 shows that the children belonging to the age between 10 to 12 years are the majority section of poorly controlled group.

Second comes less than 6 years aged children with 70% with poor control.

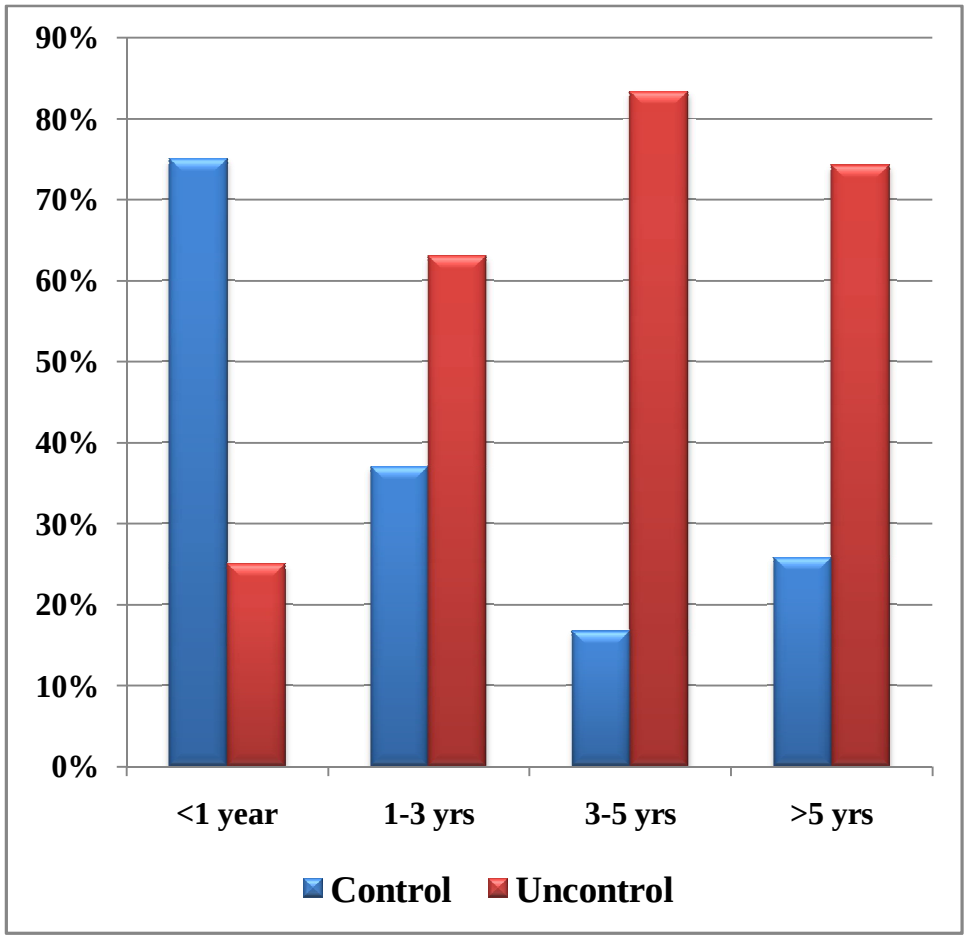
DURATION OF DIABETES WITH HbA1C

			HbA1c gp		Total
			Control	**Un control**	
Duration of disease	< 1 year	Count	3	1	4
		% within Dur disease	75.0%	25.0%	100.0%
	1-3 yrs	Count	17	29	46
		% within Dur disease	37.0%	63.0%	100.0%
	3-5 yrs	Count	3	15	18
		% within Dur disease	16.7%	83.3%	100.0%
	>5 yrs	Count	8	23	31
		% within Dur disease	25.8%	74.2%	100.0%
Total		Count	31	68	99
		% within Dur disease	31.3%	68.7%	100.0%

P=0.091

Table 23 shows no significant association between duration of diabetes and glycemic control

DURATION OF DIABETES WITH HbA1C



The chart 11 shows that the maximum glycemic control is in the patients belonging to the duration of diabetes less than 1 year. The majority of the children with poor control are more than 3 years among that 3 to 5 years have 83.3% and more than 5 years have 74.2%.

REGIMEN OF INSULIN WITH HbA1c

			HbA1c gp		Total
			Control	**Un control**	
Regimen insulin	Twice	Count	24	53	77
		% within Reg_insulin	31.2%	68.8%	100.0%
	Thrice	Count	7	15	22
		% within Reg_insulin	31.8%	68.2%	100.0%
Total		Count	31	68	99
		% within Reg_insulin	31.3%	68.7%	100.0%

P=1.000

Table 24 shows no significant association between regimen of insulin and glycemic control

REGIMEN OF INSULIN WITH HbA1c

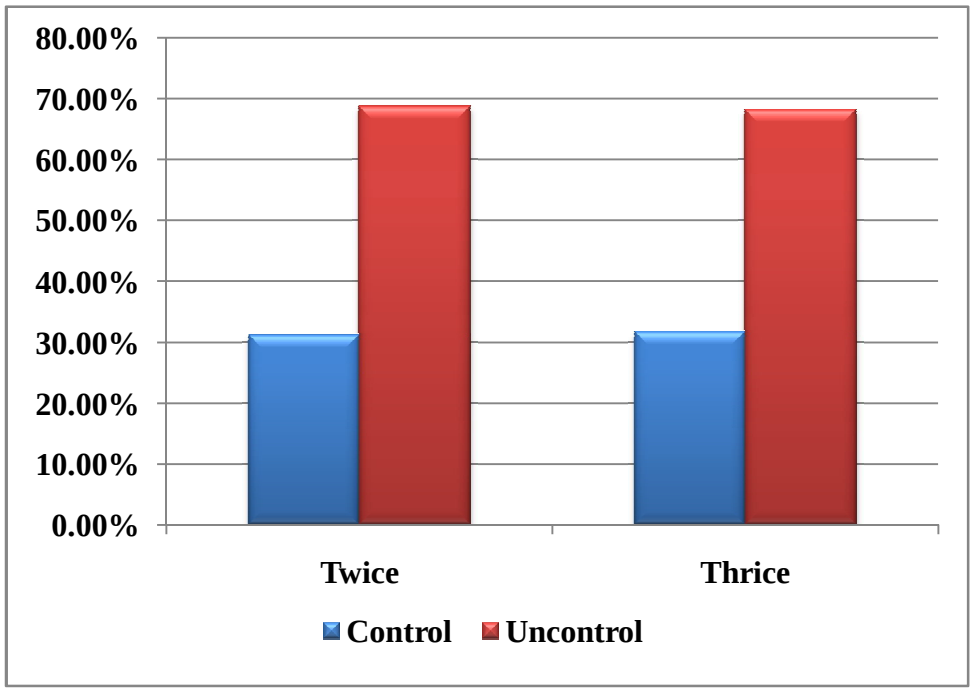


Chart 12 The above chart explains that patients with either twice or thrice regimen both have the same percentage of glycemic control.

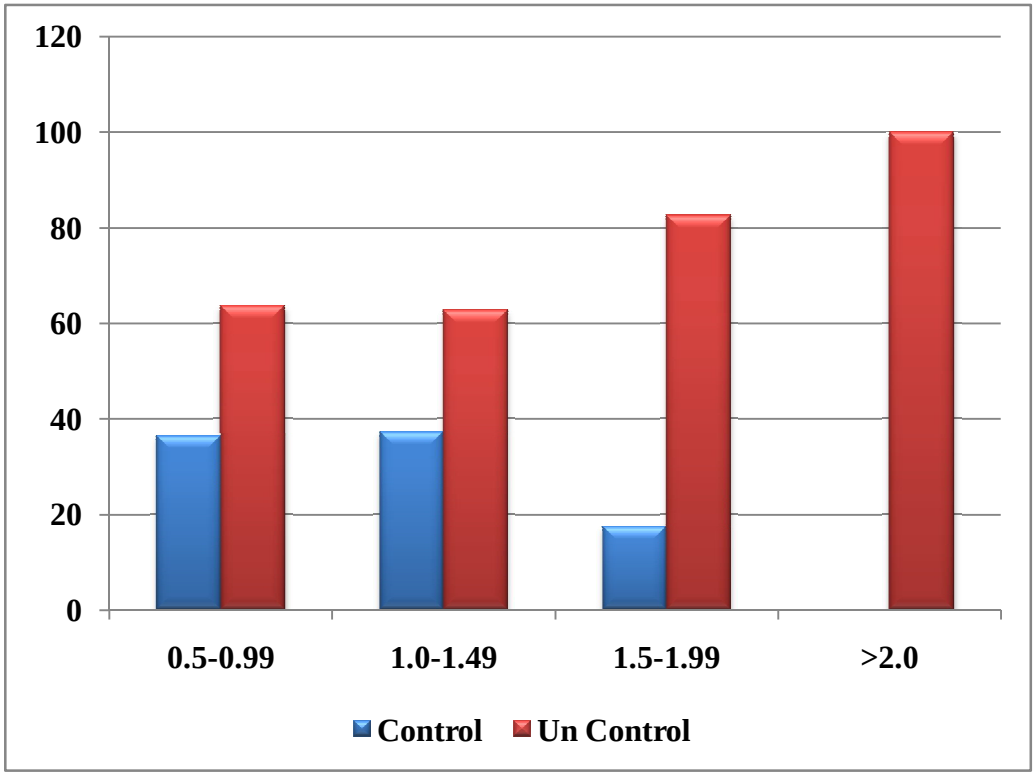
INSULIN DOSAGE GROUP WITH HbA1c GROUP

			HbA1c gp		Total
			Control	Un control	
Insulin gp	0.5-0.99	Count	8	14	22
		% within insulin gp	36.4%	63.6%	100.0%
	1.0-1.49	Count	19	32	51
		% within insulin gp	37.3%	62.7%	100.0%
	1.5-2.0	Count	4	19	23
		% within insulin gp	17.4%	82.6%	100.0%
	>2.0	Count	0	3	3
		% within insulin gp	0%	100.0%	100.0%
Total		Count	31	68	99
		% within insulin gp	31.3%	68.7%	100.0%

P=0.209

Table 25 Shows no significant association between insulin dosage and glycemic control

INSULIN DOSAGE WITH HbA1c



The chart13 shows that the poor control children are having a higher insulin dose

SMBG WITH HbA1c

			HbA1c gp		Total
			Control	Un control	
SMBG	twice a week	Count	28	56	84
		% within SMBG	33.3%	66.7%	100.0%
	Less than twice a week	Count	3	12	15
		% within SMBG	20.0%	80.0%	100.0%
Total		Count	31	68	99
		% within SMBG	31.3%	68.7%	100.0%

P=0.378

Table 26 shows no significant association between SMBG and glycemic control

SMBG WITH HbA1c

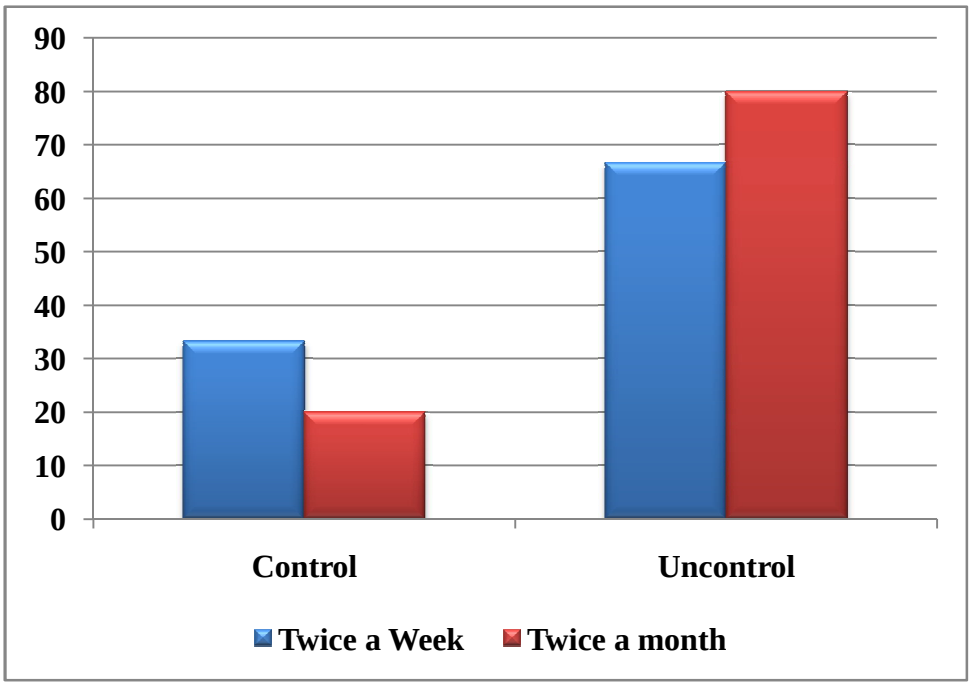


Chart 14 The bar diagram shows that the children who do SMBG twice a week had a good control of about 33.3% and poor control of about 66.7%.It also shows that the children who are doing SMBG less two times a week had a percentage of 20% and 80% for the good control and poor control respectively.

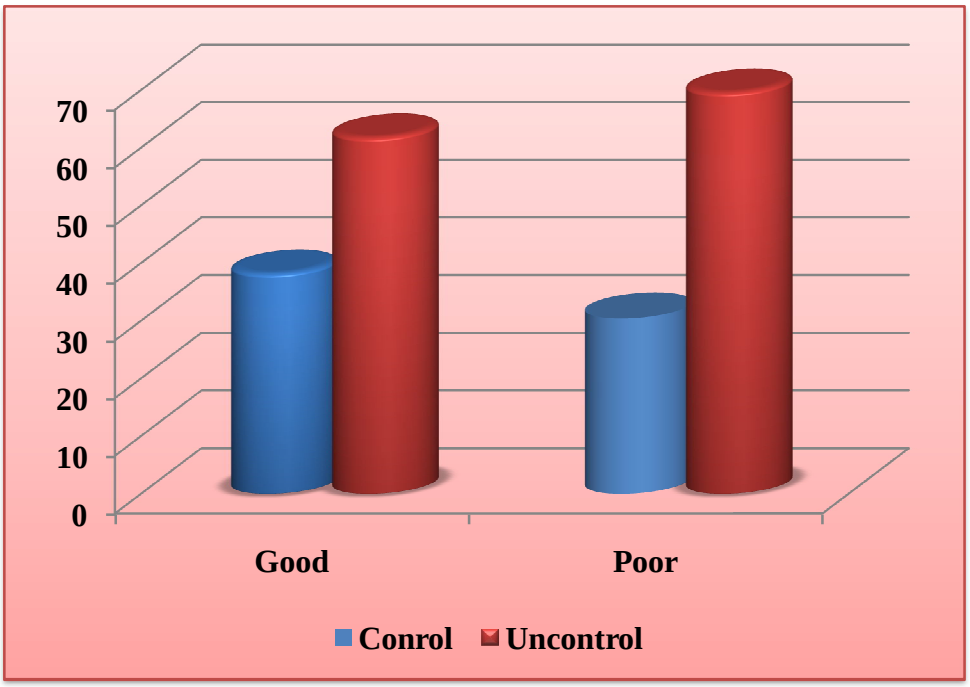
COMPLIANCE WITH HbA1c

Compliance group with HbA1c group					
			HbA1c gp		Total
			Control	Un control	
Compliance group	Good	Count	29	47	76
		% within complian_gp	38.2%	61.8%	100.0%
	Poor	Count	7	16	23
		% within complian_gp	30.4%	69.6%	100.0%
Total		Count	36	63	99
		% within complian_gp	36.4%	63.6%	100.0%

P=0.669

Table 27 shows no significant association between compliance and glycemic control

Compliance with HbA1c



The given chart 15 shows that the children with good compliance had a glycemic control of about 38.2% whereas children with poor compliance had a control of about 30.4 %, further both the groups had a poor glycemic control of about 61.8% and 69.6% respectively.

FOLLOW UP GROUP WITH HbA1c

			HbA1c_gp		Total
			Control	Un control	
Follow up group	Regular(>=10 visits)	Count	15	29	44
		% within followup gp	34.1%	65.9%	100.0%
	Irregular(<10 visits)	Count	16	39	55
		% within followup gp	29.1%	70.9%	100.0%
Total		Count	31	68	99
		% within followup gp	31.3%	68.7%	100.0%

P=0.753

Table 28 shows no significant association between follow up and glycemic control

FOLLOW UP GROUP WITH HbA1c

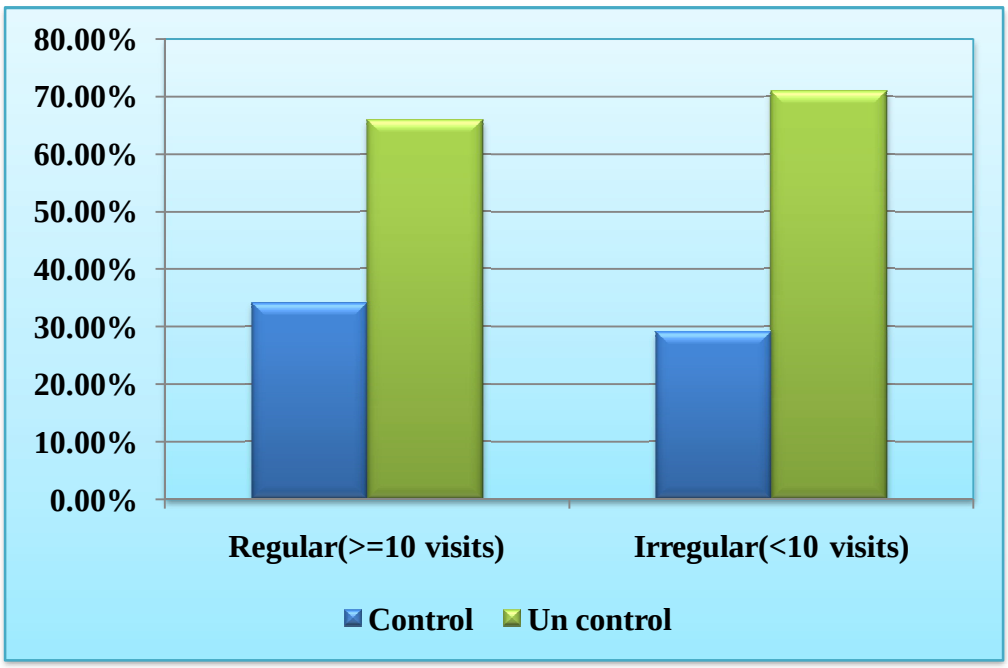


Chart 16 The bar diagram shows that the patients who came for regular visits had a control of 34.1% and 65.9% of good and poor control respectively. The patients on irregular visits had a good of about 29.1% and poor control of 70.9%.

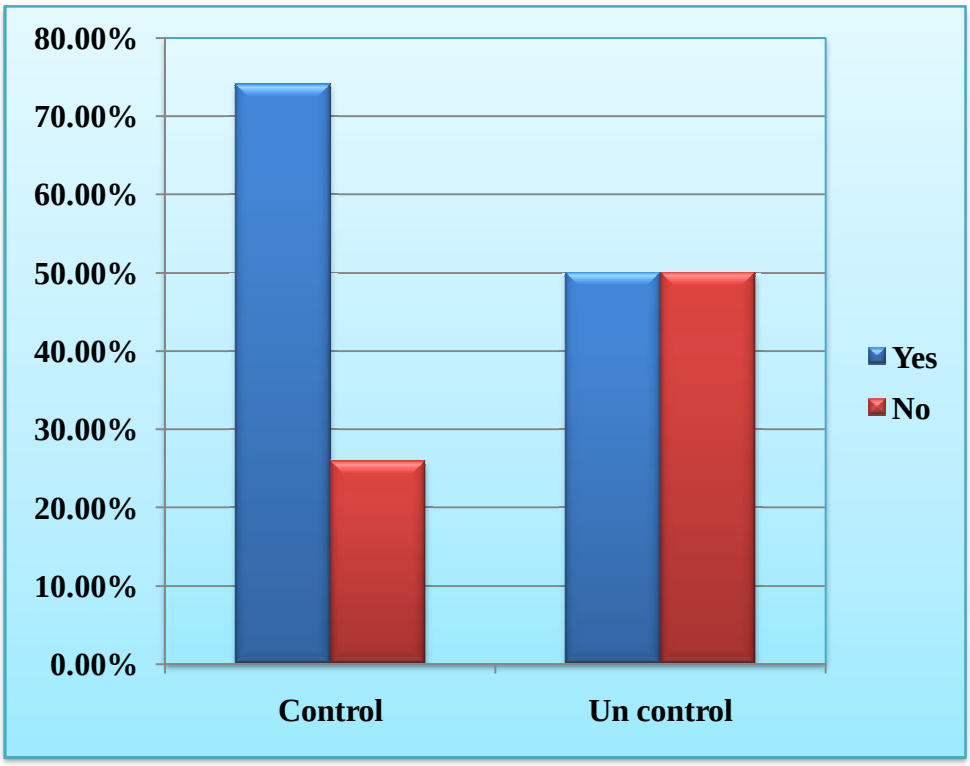
HYPOGLYCEMIC EPISODES WITH HbA1c GROUP

			Hypoglycemia		Total
			Yes	No	
HbA1c	Control	Count	23	8	31
		% within hypo group	74.1%	25.9%	100.0%
	Un control	Count	34	34	68
		% within hypo group	50%	50%	100.0%
Total		Count	57	42	99
		% within hypo group	57%	42%	100.0%

P=0.041

Table 29 shows significant association between hypoglycemic episode and glycemic control

HYPOGLYCEMIC EPISODES WITH HbA1c GROUP



The chart 17 on hypoglycemic episodes explains that good control children had an hypoglycemic episodes of 74.1% and 25.9% did not have hypoglycemia. Further the poorly controlled children had a 50% chance of hypoglycemia. Overall there was a significant episodes of hypoglycemia of a p value of 0.041.

HOSPITALIZATION WITH HbA1c

			HbA1c gp		Total
			Control	Uncontrolled control	
Hospitalization	Yes	Count	3	18	21
		% within Hospitalization	14.3%	85.7%	100.0%
	No	Count	28	50	78
		% within Hospitalization	35.9%	64.1%	100.0%
Total		Count	31	68	99
		% within Hospitalization	31.3%	68.7%	100.0%

P=0.103

Table 30 shows no significant association between hospitalization and glycemic control

HOSPITALIZATION WITH HbA1c

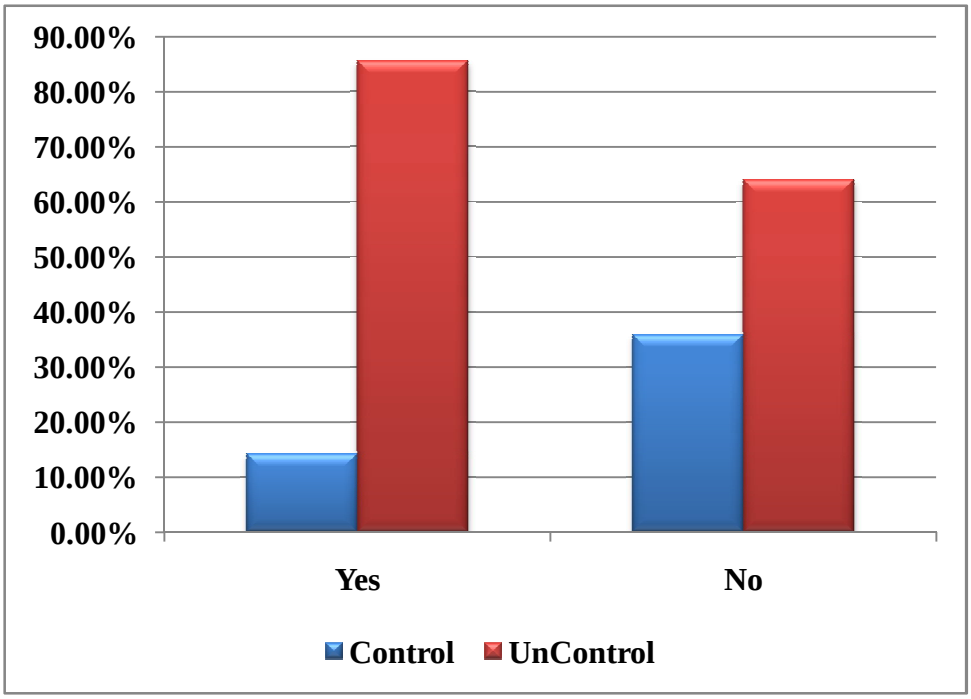


Chart 18

In the given chart hospitalization incidence was seen in14.3% in good controlled patients where as it was about 85.7% in the uncontrolled patients**.**

CHOLESTEROL WITH GLYCEMIC CONTROL

			HbA1c group		Total
			Control	Un control	
Chol group	Normal	Count	17	30	47
		% within chol group	77.3%	65.3%	69.1%
	Abnormal	Count	5	16	21
		% within chol group	22.7%	34.7%	30.9%
Total		Count	22	46	68
		% within chol group	100%	100%	100.0%

P=0.468

Table 31 shows no significant association between serum cholesterol and glycemic control

DISCUSSION

The management of Type 1 DM in Children is a great challenge for health care workers, patients and their family members. Current management standards target on optimizing glycemic control to reduce the risks of long term complications (40).

Impact of Age on glycemic control:

In the current study, the children in higher age group had maximum number with poor control i.e.75.5% whereas good control was present only in 24.5%. Further these children had a mean HbA1c level of 9.5%. This finding is similar to the western studies.

Urbach et al conducted a cross sectional study in 155 children and adolescents with type 1 dm in Portland. He observed that mean HbA1c level was 9.3% and also observed that adolescents had a poor glycemic control with HbA1c level 0.56 higher than that of children aged 2 to 8 years (41).

It has been found that increasing age group was associated with poor glycemic control by Vinelli M et al (42). This may be attributed to increase in counter regulatory hormones and decrease in insulin sensitivity during the early stage of puberty. Additionally, this age group

is vulnerable to psychological and social stressors which may result in poor control. The poor glycemic control with increasing age in current study may be attributed to pubertal changes.

The current study also shows that 70% of the children belonging to 1 to 6 years of age had a poor glycemic control this may be attributed to the fact that these children are difficult to manage as they have a variable food intake and activity levels. In addition the early signs of hypoglycemia are difficult to recognize.

Impact of duration of diabetes on glycemic control

In the current study it is observed that children with duration of diabetes less than 1 year have 75.0% control while children with duration of diabetes more than 3 years have the least control of 16.7%.

This is similar to the wisconsin Diabetes registry done by Gvan-Hua Hvang et al which shows that those with shorter duration of diabetes have better control.(43)

This is an expected finding in newly diagnosed children of type1 DM. This finding may be attributed to the honey moon effect, in this period a relatively good glycemic control occurs due to residual β –cell effect.

Further in this study it is observed that increase in the duration of T1DM resulted in poorer control but it is not statistically significant as stated in other studies.

Craig et al conducted cross sectional study in Australia in 1190 children with T1DM and has observed that duration of diabetes a significant predictor of glycemic control. (17),(18).But the current study did not observe diabetes duration as a significant predictor.

Impact of regimen of insulin on glycemic control

The current study shows that glycemic control is similar in both twice daily and multiple dose regimens. The DCCT has proven that intensive insulin regimen have demonstrated advantages over the more conventional insulin therapy(44). The finding in the current study could be explained by the fact that only patients with poor glycemic control were started on thrice daily regimen as per our unit protocol whereas those with good control were maintained on twice daily regimen.

Impact of SMBG on glycemic control

In the current study the patients who had monitored their glucose levels twice a week had a higher rate of glycemic control (33.3%)

compared to the other group who monitored less frequently(20%), but this difference was not statistically different.

The study conducted by Anderson et al found where more parental involvement in blood glucose measurement resulted in Lower HbA1C Levels.(45) The lack of this association in the current study could be explained by the reasons for poor adherence to blood glucose measurement in our population and poor maintenance of records. In the current study population it was not practical to download data from blood glucose meter as most patients did not carry meters to the clinic during visits.

Impact of compliance to therapy on glycemic control

The current study on compliance has shown that children with good compliance had a glycemic control of 38.2% compared to the poor compliance group who has only 30.4 % glycemic control, though not statistically significant.

Hood et al and peterson et all conducted a meta –analysis in 2492 youth with type 1 DM in cincinnati, Ohio has found that and as the adherence increase the HbA1C value decreases.(16)

Impact of follow up on glycemic control

In the current study the glycemic control in children with regular follow up is 34.1% compared to the children with irregular follow up who has a percentage of 29.1, the difference not being statistically significant.

A study conducted in portland by Urbach SL et al, La Franchiet al among 155 children of Type I DM revealed that children who attended the clinic irregularly had a poor HbA_1C value(41).

Impact of glycemic control on hypoglycemic episodes

In the current study, episodes of hypoglycemia occurred in about 57.6% and 42.4% of children did not have hypoglycemic episodes, which is comparable to other studies. Craig et al conducted study regarding glycemic control and complication in children with Type I DM in Asia and western pacific region and observed the incidence of hypoglycemia is 73 per 100 patient per year (17). Similar study conducted by Levine et al observed 62 per 100 person-years (46)

On comparing the good control and poor control groups, 74.1% of the children in good control group had statistically significant hypoglycemic episodes while in the poorly controlled group only 50% had hypoglycemia. Hypoglycemia is the limiting factor to tight glycemic

control in insulin-treated subjects since hypoglycemia can lead to cognitive dysfunction in children. DCCT in their studies have reported that lower glycated haemoglobin (HbA1c) level was a consistent risk factor for severe hypoglycaemia (7). However compromising glycemic control for hypoglycemia also has its own demerits of microvascular complications.

Experts agree that at present, safest recommendation for improving Glycemic control generally in all children is to achieve the lowest HbA1c that can be sustained without causing hypoglycemia while avoiding prolonged periods of significant hyperglycemia.

Hospitalization

In the current study, there were 21 children hospitalized for inter current illness. This is comparable to the study conducted by Levine BS et al who observed the overall incidence rate of hospitalization was 13 per 100 person-years(46). This is more than 3 times the rate in general population.

Impact of lipid profile on glycemic control

M. Loredana Marcovecchio et al made a longitudinal study in a population of 895 young subjects with type 1 diabetes with mean diabetes duration of 4.8 yrs and concluded that sustained, significant lipid abnormalities were related to age, BMI, duration and HbA1C (47).

In the current study it was found that the elevated lipid profile especially sr.cholesterol was seen in about 22.7% in good glycemic controlled patients compared to 34.7% in patients who have poor control.

STUDY HIGHLIGHTS

The HbA1c values used in the study were not a single reading, but mean of all the values in the preceding year. Hence it reflected the child's glycemic control over the one full year and was thus a reliable and stable parameter**.**

STUDY LIMITATIONS

Including equal number of patients in different categories can bring out the effect of relation between that particular factor and glycemic control.

This was not possible in the present study and that could have jeopardized the result, hence statistically significant results could not be obtained.

SUMMARY

- A total of 99 children with Type I DM were included in this study.
- The mean HbA1c was 9.2% comes under fair control group.
- The glycemic control of 31.3% children came within the age appropriate glycemic control range.
- The glycemic control of 68.7% children was above the age appropriate glycemic control range.
- The following factors namely age, duration of diabetes, insulin dose, insulin regimen, SMBG, compliance to therapy, follow up, serum cholesterol and serum triglyceride did not have any impact on the glycemic control of type 1 diabetes in children.
- Hypoglycemic episodes were found to be more common in children with good glycemic control which was statistically significant.

CONCLUSION

The glycemic control in children with Type I DM attending the diabetic clinic at ICH & HC have a fair metabolic control.

Hypoglycemic episodes were found to be more common in children with good glycemic control which was statistically significant.

From the current study, there is no evidence to suggest that demographic factors, diabetes related factors and comorbid condition had impact on the glycemic control in children with type 1 diabetes.

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ஒப்புதல் படிவம்

ஆராய்ச்சி நடத்தப்படும் இடம் : சர்க்கரைப் நோய் பிரிவு அரசு
குழந்தைகள் நல மருத்துவமனை
மற்றும் ஆராய்ச்சி நிலையம்,
எழும்பூர், சென்னை – 600 008.

ஆராய்ச்சியாளரின் பெயர் : மரு. செல்வகுமார்
பட்ட மேற்படிப்பு மாணவர், குழந்தைகள் நல பிரிவு,
அரசு குழந்தைகள் நல மருத்துவமனை மற்றும்
ஆராய்ச்சி நிலையம், சென்னை -8.

பங்கேற்பாளரின் பெயரின் : வயது : பாலினம் :

மருத்துவமனை எண் :

1. எனக்கு இந்த ஆராய்ச்சி குறித்து முழுவதுமாகவும், விரிவாகவும் எடுத்துரைக்கப்பட்டது.
2. எனக்கு இந்த ஆராய்ச்சியில் இருக்கும் உரிமை மற்றும் பங்கேற்பும் எடுத்துரைக்கப்பட்டது.
3. நான் என் முழுமனுதுடன் என் குழந்தை இந்த ஆராய்ச்சியில் பங்கேற்க சம்மதிக்கிறேன்.
4. எனது குழந்தை ஆராய்ச்சியாளருக்கு இறுதிவரை ஒத்துழைப்பு வழங்கும் என உறுதி அளிக்கின்றேன்.
5. எனக்கு எனது குழந்தைக்கு இந்த ஆராய்ச்சியினால் ஏற்படும் நன்மைகள் மற்றும் தீமைகள் பற்றி நன்றாக எடுத்துரைக்கப்பட்டது.
6. எனது குழந்தை இதற்கு முன் வேறு ஆராய்ச்சியில் பங்கேற்கவில்லை என்று உறுதி அளிக்கிறேன்.
7. நான் எப்பொழுது வேண்டுமானாலும் எனது குழந்தையை இந்த ஆராய்ச்சியில் இருந்து விலக்கிக் கொள்ளலாம் என்று எனக்கு எடுத்துரைக்கப்பட்டது.
8. என் குழந்தையிடம் இருந்து பெறப்படும் விவரங்களும் எனது குழந்தையின் தன்னடையாளங்களும் வேறு யாருக்கும் தெரிவிக்கப்படமாட்டாது என எனக்கு உறுதி அளிக்கப்பட்டது.
9. எனக்கு ஏதேனும் இந்த ஆராய்ச்சி குறித்து சந்தேகம் இருப்பின் அதனை உடனே ஆராய்ச்சியாளரிடம் கேட்டு தெளிவு பெற்றுக்கொள்வேன் என்று உறுதி அளிக்கிறேன்.

ஆராய்ச்சியாளரின் கையொப்பம் பங்குபெறும் குழந்தையின் பெற்றோர் /
பாதுகாவலரின் கையொப்பம்

நாள் :

DATA COLLECTION FORM

Participant ID no: Address:

P: Personal Characteristics

1.	Serial no		
2.	Name:		
3.	Age	1=(1to6) 2=(6 to10) 3=(10-12)	Code ☐
4.	sex	1=M 2=F	Code ☐
5	BMI	1. Above 3 Obese 2. Between 2 to 3 Overweight 3. From 1 to 2 possible risk of overweight 4. From 1 to -2 Normal 5. From -2 to -3 wasted 6. Below -3 Severly wasted	Code ☐
6	Primary care giver	1=father 2=mother 3=sibling 4=guardian	☐
7.	Educational profile of the caretaker	1=illiterate 2=primary school certificate 3=middle school certificate 4=High school completed 5=intermediate or post school diploma 6=Graduation or post-graduation completed 7=professional course completed	Code ☐

8	Family structure	1=both parents living together 2=single parent 3=no parent	Code ☐
9	Family history of DM	1=yes a)1st degree b)2nd degree c)3rd degree 2=no	Code ☐
10	Mode of DM onset	1=DKA 2=Non DKA	Code ☐
11	Duration of disease	1=<1yr 2=1-3yrs 3=3-5yrs 4=>5yrs	Code ☐
12	Regimen of Insulin	1=twice daily 2=thrice daily	Code ☐
13	Insulin dose (units/kg)		
14	Mode of insulin administration	1=pen 2=conventional	☐
15	SMBG	1=twice a week 2=twice a month 3=once a month 4=> once a month	Code ☐
16	Compliance to therapy	1=good 2=poor	Code ☐
17	Follow up	1=regular 2=irregular	Code ☐
18	Hypoglycemic episodes	1=yes 2=no If yes whether 1=symptomatic 2=asymptomatic	Code ☐ Code ☐

19	Hospitalization for inter current illness	1=yes 2=no	Code ☐
20	Episodes of DKA	1=yes 2=no	Code ☐
21	HbA1c		
22	Lipid profile		
23	Thyroid profile		

Sl.No.	Name	OP.NO.	Age	Sex	BMI	care giver	Edu. Of Parents	Fam. Struct.	Fam H/O DM	Mode of onset	Duration	Regimen	Insulin dose	MODE	SMBG	Compliance	Follow up	Hypoglycemia	Hospitalisation	Episodes of DKA	HbA1c 1	HbA1C 2	HbA1c 3	Sr.choles	Sr.TGL	T3	T4	TSH
1	Sadhana	472	1	2	4	2	5	1	2	1	2	1	1.3	2	1	1	1	1a	2	2	8	8.5	8	154	NA	0.67	67	3.5
2	shanmugapriyo	426	3	2	4	2	6	1	1b	2	3	1	1	2	1	1	1	1a	2	2	8.1	10.3		70	95	1.4	112	4.2
3	kavishankar	491	2	1	4	2	6	1	2	2	2	1	1	2	1	1	2	1a	2	2	8.5	6.1		NA	NA	1.2	94	2.6
4	ariyan	432	2	1	4	2	3	1	2	2	3	1	1.3	2	1	1	2	1a	2	2	9.6	7.5		NA	NA	0.95	55	2.5
5	kamaleshkumar	414	3	1	4	2	3	1	2	2	3	2	1.4	2	1	1	1	1b	2	2	11.4	8.5	9	86	78	2.02	46	4.7
6	Abinayasri	569	3	2	4	2	4	1	2	2	2	1	1.2	2	1	2	2	1b	2	2	12.1	9.1		161	74	1.7	95	3.6
7	Keerthana	558	3	2	6	2	4	1	2	2	2	1	1.7	2	1	2	2	2	2	2	10.5	9.8		150	56	0.88	90	1.2
8	Aswini	587	2	2	4	2	4	1	2	1	2	2	1	2	1	1	1	1a	2	2	8.5	6.6	8	168	113	1.2	99	1.8
9	Bavatharani	500	2	2	4	2	6	1	2	2	2	1	1.16	2	1	1	2	1a	2	2	9.5	8		NA	NA	1.8	87	2.7
10	DIVYA	297	5	2	4	2	5	1	2	1	4	1	2	2	1	2	1	1b	1	2	13.2	11	10.5	NA	NA	3.4	12.8	6.1
11	dhakshanya	407	2	2	4	2	4	1	2	1	3	1	1	2	1	1	2	2	2	2	7.4	7		164	103	1.5	98	2.1
12	danush	505	2	1	4	2	1	1	1a	2	2	1	1.5	2	1	1	2	2	2	2	8	9.5		138	69	1.2	103	3.6
13	Jabina	543	3	2	4	2	4	1	2	1	2	1	0.61	2	1	1	1	1a	1	1	8.8	5.4	6.5	133	64		45	1.35
14	kumaravel	289	3	1	4	2	4	1	2	2	4	2	0.7	2	2	1	1	2	2	2	6.2	7.2	7	187	104	0.9	84	18
15	srivishal	535	3	1	4	2	3	1	2	2	2	1	1.5	2	1	1	1	2	2	2	8.9	8.4	6.8	184	82	1.6	99	1.2
16	selvi	507	2	2	4	1	3	1	2	1	2	1	0.7	2	1	1	2	1a	2	2	6.3	7.4		140	58	1.1	127	1.5
17	hariharan	473	3	1	3	1	5	1	2	2	2	1	1.1	2	2	1	2	1b	2	2	6.6	6.5		159	100	1.5	86	1.8
18	VVBNESH526	526	3	1	4	1	4	1	2	2	2	1	1.4	2	1	1	1	1a	1	1	6.5	6.3	6.6	NA	NA	0.99	113	0.46
19	Pincy 554	554	3	2	6	2	2	3	2	1	2	2	1.4	2	1	1	2	1b	2	2	8.6	7.8	11	NA	NA	1.1	84	4.6
20	samshad 442	442	2	2	3	2	3	1	1a	2	3	1	1.1	2	1	1	1	1a	2	2	8.4	9.4	8.6	NA	NA	1.4	98	3.4
21	reshma 492	492	3	2	4	2	3	1	2	1	2	1	1.1	2	1	1	1	2	2	2	7.3	9.2	8	190	76	1.7	106	2.2
22	arunkumar172	172	3	1	4	2	2	2	2	1	4	1	1.3	2	2	2	2	1a	1	2	11.7	12.3		143	88	2.6	11.5	1.21
23	veeramani 567	567	1	1	4	2	3	1	2	2	2	1	1	2	1	1	2	2	2	2	5.5	5.7		270	104			
24	nazeena 246	246	2	2	3	2	3	1	2	1	4	1	1.3	2	1	1	1	1a	1	1	7.6	9.7	8.1	242	188	1	114	3.6
25	jenifer 441	441	2	2	2	2	5	1	2	2	3	2	1.1	2	1	1	2	2	2	2	11	11.2		174	141	1.2	81	6.5
26	vishal 309	309	3	1	4	2	4	1	2	2	4	1	0.8	2	1	1	2	1a	2	2	10	10.6	10	NA	NA	0.7	99	12.7
27	bharath 301	301	2	1	4	2	4	1	2	1	4	1	0.9	2	2	1	2	1b	1	2	9.3	9.1		164	103	1.5	98	2.1
28	naveenkumar	344	3	1	4	2	5	1	2	1	3	1	1.6	2	1	2	2	1a	1	2	13.2	11		NA	NA	2.3	12.8	3
29	vishali 157	157	3	2	4	2	4	1	2	1	4	1	1.2	2	1	2	2	1a	1	2	11.8	13.8		NA	NA	1.4	12	4.29
30	chandra 563	563	2	2	4	2	5	1	2	2	2	1	0.9	2	1	1	2	1a	2	2	7.8	7		126	26	1.2	75.5	1.941
31	santhosh 269	269	5	1	4	1	6	1	2	2	4	1	1.2	2	1	1	1	2	2	2	9.8	8.6		NA	NA	1	92	2.4
32	surya 572	572	3	1	4	2	3	1	2	1	2	1	1.08	2	1	1	2	1a	2	2	11.6	8.7	8	201	175	1.2	91	3.3
33	hemanth 167	167	3	1	4	2	4	1	2	1	4	1	1.16	2	1	1	2	1a	1	2	11.2	9.9		166	92	0.9	78	4.1
34	sruthi 162	162	3	2	4	2	6	1	2	1	4	1	1	2	1	1	1	2	2	2	7.6	7.5	8.5	105	72	0.6	40	1.927
35	hashwini 409	409	2	2	4	2	6	1	2	1	3	1	1.7	1	1	1	2	1a	2	2	7.9	6.6	7.3	168	113	1.3	81	8.2
36	farhad 346	346	3	2	4	2	4	1	2	2	4	1	0.8	2	1	2	2	1a	2	2	9.5	11.6		NA	NA	1.4	114	2.7
37	abinaya 482	482	2	2	4	2	3	1	2	2	3	1	1.6	2	1	1	1	2	2	2	6.2	6.5	6	NA	NA	0.89	10.8	1.09
38	sribha 553	553	3	2	4	2	6	1	2	2	2	2	1.5	2	2	2	1	2	2	2	10.6	11.8	11.2	192	109	1.2	95	0.8
39	sivagami 287	287	3	2	5	2	3	1	2	1	3	1	1	2	2	1	2	1b	1	1	8.1	8.4		137	220	0.8	96	1.5
40	tamilselvan 580	580	1	1	4	2	1	1	2	1	2	1	nil	2	1	1	1	2	2	2	9.3	7.5	8	NA	NA	0.9	76	6.2
41	ashika 437	437	3	2	4	2	5	1	2	2	2	2	2.5	2	1	2	2	2	1	2	14.5	11.8		NA	NA	0.54	108.8	2.7
42	karthik 375	375	2	1	4	3	5	1	2	1	4	1	1.2	2	1	1	1	2	2	2	7.9	7	8.5	NA	NA	1.9	102	1.8
43	Jamuna	583	2	2	4	2	4	1	2	1	2	2	1.3	2	2	1	2	1a	2	2	11.2	12.2		NA	NA	1.3	87	3.7
44	boobesh 139	139	3	1	4	2	3	1	2	1	4	2	1.4	2	2	2	2	1b	2	2	12.1	12.6		207	82	1.4	91	3.6
45	swetha 355	355	3	2	4	2	6	12	2	2	4	1	1.2	2	1	1	1	1a	2	2	7	6.5	9	152	31	1.6	104	1
46	lokeshwari 485	485	3	2	6	2	4	1	2	1	2	1	1.3	2	1	2	1	1a	2	2	7	6.9	6.8	181	99	1.1	84	2.3
47	deepak 415	415	2	1	4	2	1	1	2	1	3	1	1	2	1	1	1	2	1	2	11.5	12	12.5	165	116	1.8	72	2.4
48	keerthana 477	477	3	2	4	1	4	1	2	2	3	1	1.08	2	1	2	2	1a	2	2	9.8	9.5		102	62	0.661	48	1.8
49	deena 547	547	3	1	4	4	4	3	2	2	2	1	0.8	2	2	2	2	2	2	2	9.1	9.9		NA	NA	0.693	81.7	2.89
50	manish 546	546	1	1	4	2	5	1	2	2	2	2	0.8	1	1	1	2	2	2	2	9.7	10.1		150	100	1.4	94	3.5
51	reshitha 446	446	3	2	5	2	2	1	2	1	2	2	1.9	2	1	1	1	1a	2	2	7	7.3		157	98	1.5	98	2.6
52	vignesh 178	178	3	1	4	2	3	1	2	2	4	1	1	2	1	1	2	1a	2	2	9.4	7.8		NA	NA			
53	priyanka	238	3	2	5	2	4	1	2	2	2	1	1	2	1	1	2	1a	2	2	8.1	8.3	8.7	221	73	1.5	96	1.8
54	kayiya 586	586	1	2	4	2	4	1	2	1	2	1	1.6	2	2	1	1	2	2	2	13.5	8.1	10.5	NA	NA	0.1	41.3	2.5
55	suchithra 588	588	2	2	4	2	1	1	2	2	2	1	1	2	1	1	1	2	2	2	11.5	6.6	9	NA	NA		84	4.5
56	manishkumar	297	3	1	4	2	4	1	2	1	4	1	1.12	2	1	1	2	1a	2	2	9.1	7.5		85	98	143	11.2	2.79
57	veeralakshmi	533	2	2	4	2	4	1	2	1	2	1	1.46	2	1	1	1	1b	2	2	7.5	12.9	11	183	69	1	79	1.8
58	naveenraj	531	3	1	4	1	4	1	2	2	2	1	1.75	1	1	2	1	1b	2	2	10.7	8.5	9	177	85	1	92	3.3
59	rupasree	209	3	2	4	2	1	1	2	2	4	1	0.75	2	1	2	2	1a	1	1	12.2	12.3		111	147	0.8	76	6.8
60	haswitha	574	2	2	4	2	5	1	2	2	2	1	0.56	2	1	1	1	1a	2	2	11.5	5.8	6.6	114	58	1.4	96	2.9
61	anusha	530	3	2	4	2	1	1	2	2	2	1	0.95	2	1	1	1	2	2	2	9.4	8.1	8	156	105	1.3	79	3.5
62	santhalakshmi	541	3	2	4	1	5	1	2	1	2	1	1	2	1	1	1	2	2	2	8	7.3	7.5	119	64	1.6	112	3.1
63	venkatesh	576	3	1	4	2	1	1	2	1	2	1	1.5	2	1	1	1	2	2	2	12.1	8.6	8.5	124	107	1.3	112	2.3
64	raja	516	2	1	4	2	6	1	2	2	2	1	0.9	2	1	1	1	1a	2	2	5.7	5		144	60	1.2	67	6.5

65	thillagavathy	544	3	2	4	2	5	1	2	2	2	2	1.97	2	1	1	1	1b	2	2	7.2	6.8		291	196	0.7	78	5.3
66	aishwarya	524	3	2	3	4	4	3	2	1	2	1	1	2	2	2	1	1a	2	2	9.2	11.7	10.5	138	81			
67	pownkumar	467	3	1	5	2	2	1	2	2	2	1	1.7	2	1	1	2	1b	2	2	7.8	8.9	8.5	165	104	0.9	94	0.6
68	bharath	501	1	1	4	2	4	1	1a	1	2	1	1.68	2	1	1	2	1a	2	2	9.5	9		NA	NA	0.9	96	3.2
69	yuvaraj	508	2	1	6	2	5	1	2	1	2	1	1.4	2	1	1	2	2	2	2	8.3	7.7		NA	NA	1.2	92	9.2
70	vinothkumar	500	2	1	6	2	4	1	2	1	2	1	0.8	2	1	1	2	1a	2	2	9.5	9.1	9.1	120	70	1.2	94	2.6
71	santhosh	599	1	1	4	2	4	1	2	2	2	1	1.2	2	1	1	2	1b	1	2	9.5	8		134	65	1.5	90	2
72	yuvasankar	494	3	1	4	2	4	1	2	1	2	2	1.57	1	1	2	2	2	2	2	10.9	10.5		180	122	1.1	86	1.5
73	parvendan	464	2	1	4	2	2	1	2	1	2	1	1.25	2	1	1	2	2	2	2	7.3	8.8		NA	NA		140	0.6
74	soundarya	487	2	2	3	2	4	1	2	2	2	1	0.7	2	1	1	2	2	2	2	8.7	8		193	57	2.3	1.1	98
75	kamali	458	3	2	4	2	2	1	2	1	3	1	1.125	2	1	1	1	2	2	2	9.9	8.7	9	204	122	1.4	98	3.2
76	rishav parveen	470	2	2	4	2	3	1	2	2	2	1	1	2	1	1	2	1a	2	2	8.3	8.9		NA	NA	1.3	112	1.2
77	diwakar	503	3	1	4	1	6	1	2	2	2	2	1.77	1	1	2	2	2	2	2	11.1	13.2		137	77	1.4	96	2.6
78	thulasi	488	3	2	5	2	5	1	2	1	2	1	1.1	2	2	1	1	2	1	2	8.3	10.1	8.7	172	135	1.2	94	2.5
79	santhosh	538	2	1	4	2	3	1	2	1	2	1	1.25	2	1	1	2	1a	2	2	10.3	11		158	63	1.8	112	0.8
80	prakash	474	1	1	4	2	4	1	2	1	2	2	0.8	2	1	1	2	2	2	2	9	8.8		NA	NA	1.2	56	5.6
81	shinaya	487	2	1	4	1	3	1	2	2	2	1	0.6	2	1	1	2	1a	2	2	7.6	6.5	6.2	148		1.4	96	3.8
82	shekila	325	3	2	4	2	1	1	2	2	4	1	2.2	2	2	1	2	2	2	2	9.5	11.3		148	75	1.2	131	1.2
83	nandhakumar	556	3	1	3	2	4	1	2	1	2	1	1	1	1	2	2	1a	2	2	9.2	11.5	11.2	120	80	0.9	112	3.6
84	harikrishnan	463	2	1	4	2	3	1	2	1	3	1	1.1	1	2	1	1	2	2	2	10	11.5	10	NA	NA	0.88	61.69	1.922
85	dhanush	471	2	1	4	3	4	1	2	2	3	1	1.2	2	1	1	2	2	2	2	7.5	14.2		NA	NA		7.4	1.2
86	janani	496	2	2	2	2	1	1	2	2	2	2	1.6	2	1	1	1	2	2	2	11.3	11.2	11	194	103	0.9	90.5	7.7
87	kaviarasu	368	2	1	4	2	3	1	1a	1	4	2	2.5	2	2	1	1	2	1	2	14.8	9.9		145	80	1.1	102	3.2
88	sadana	472	2	2	4	2	2	1	2	1	3	1	1.29	2	1	1	1	1a	2	2	8.3	9.3	8.6	NA	NA	1.2	91	32
89	subiksha	339	3	2	4	1	5	1	1a	2	4	2	1.6	1	1	1	2	1a	2	2	9.3	7.8		202	89	1.3	84	2.6
90	henry	362	3	1	4	2	6	1	2	1	4	1	1.6	2	1	2	2	2	1	2	7.9	10.2	10.6	190	75	1.2	98	2.9
91	rikhanya	486	2	2	4	2	5	1	2	1	3	2	1.2	2	1	1	2	1b	2	2	6.8	6.5		141	84	0.6	100	1.014
92	tashima	476	1	2	4	2	1	1	2	1	3	1	0.92	1	1	1	2	1a	2	2	11.4	11		166	90	1.4	112	1.5
93	umera	294	3	2	4	2	4	1	2	1	4	2	1.83	1	1	2	1	2	1	2	12.5	10.3		208	87	0.9	62	9.2
94	vishak	309	3	1	4	2	6	1	2	1	4	1	0.97	2	1	1	1	2	2	2	10	10.6	10.5	NA	NA	1.18	7.4	16.6
95	harini	268	3	2	4	2	4	1	2	1	4	2	1.6	1	1	2	1	1a	2	2	10.8	11.1	9.2	163	179	0.44	78.9	1.162
96	sakthisree	330	3	2	4	2	3	1	2	1	4	1	1.5	2	2	1	2	2	1	2	11.4	12		161	71	1.5	98	2.5
97	hemalatha	548	1	2	4	2	5	1	2	2	2	1	0.86	2	1	1	2	1a	2	2	8.5	7.2	8.6	159			104	4.155
98	murugan	444	3	1	5	2	4	1	2	2	3	2	1.5	2	1	2	1	2	2	2	11	9.1	9.5	93	84	1.7	104	2.1
99	ashok	272	3	1	4	1	3	1	2	1	4	2	1.04	2	1	1	1	2	2	2	10.6	10.3	9.5	167	95	1.8	102	2.6